OCTOBER 1950

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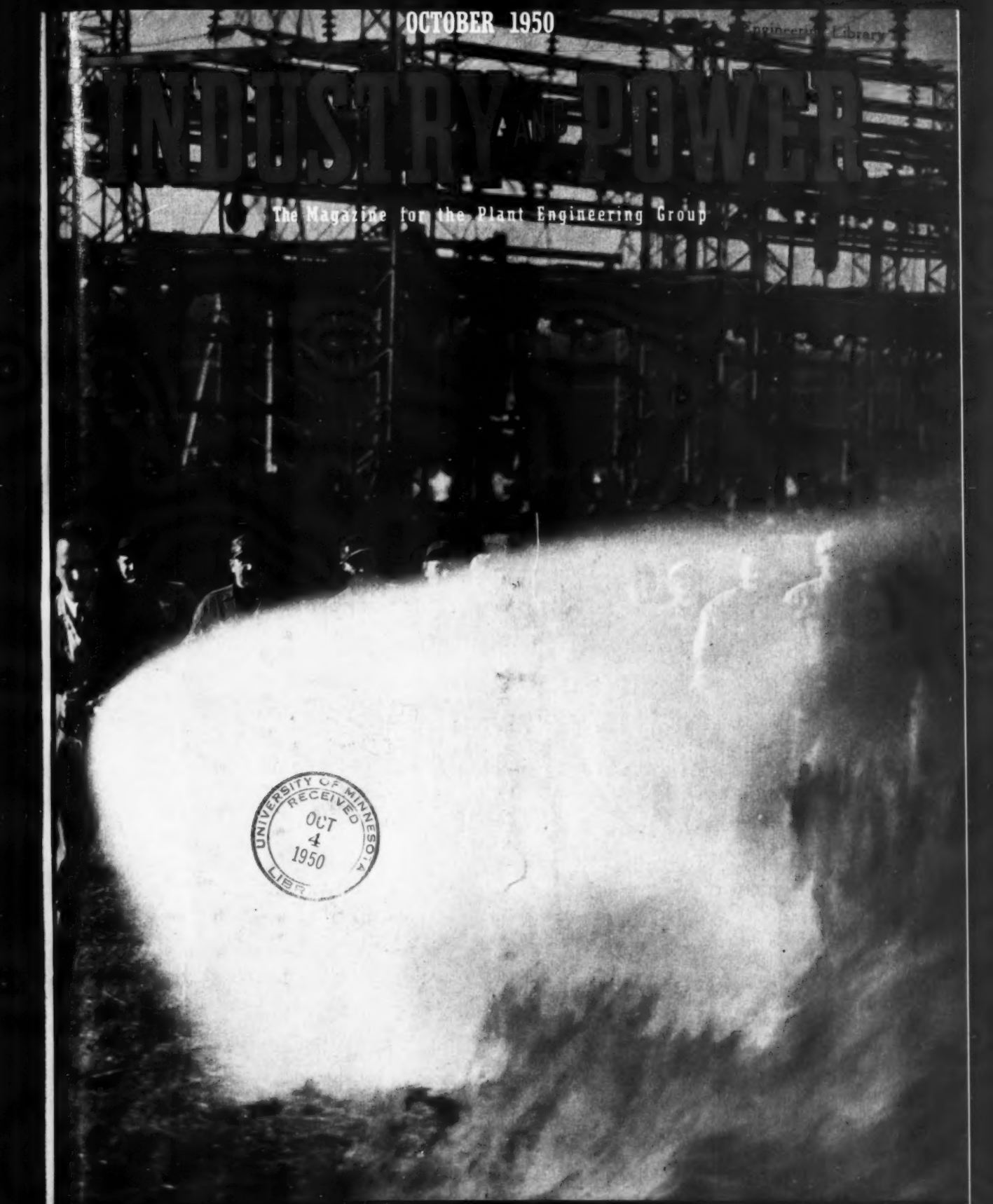
INDUSTRY AND POWER

The Magazine for the Plant Engineering Group



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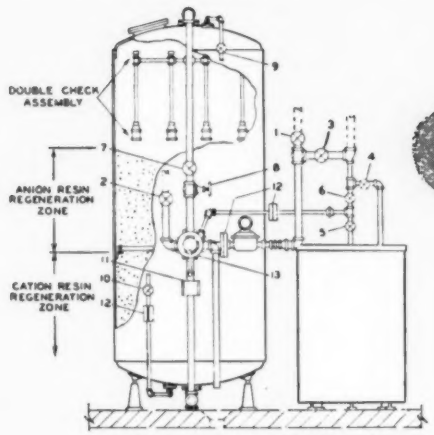
Highest Quality Mineral-Free Water At FRACTION of Evaporated Water Cost



1 Hard Water Inlet Valve
2 Deionized Water Outlet Valve
3 Soft Water Inlet Valve
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5 Regenerant Suction Valve
6 Regenerant Rinse Valve
7 Upper Manifold Valve
8 Mid-Manifold Valve
9 Air Vent Valve
10 Air Inlet Valve
11 Effluent Quality Controller
12 Rate of Flow Indicators
13 Multiport Valve

ELGIN Mono Flo DEIONIZER

(single tank unit)

Only 18c* per 1000 gallons compared with $5.00 per 1000 gallons for evaporated water

**Based on 10 grain water*

SOME OF OUR OTHER PRODUCTS

- Zeolite Water Softeners
- Dealkalizers
- Silica Removers
- Degasitors
- Water Filters
- Corrosion Control
- Feedwater Treatment
- Chemical Feed Systems
- Iron Removal Equipment
- Water Treating Chemicals
- Water Testing Equipment

Write for Bulletins

Here is a truly revolutionary development—a single tank "monobed" deionizer that brings the cost of high quality demineralized water within the range of those who have heretofore found evaporated or distilled water prohibitive in cost. Here is the perfect boiler feedwater that assures freedom from scale, corrosion, carryover and costly blowdown. Yet the overall cost is comparable with ordinary water conditioning equipment or treatments.

The single column Elgin DeIonizer produces water of higher quality than delivered by two and four-column demineralizers. In fact, for nearly all purposes, the water is freer from impurities than *distilled* water — and at a fraction of the cost. Naturally the compact Elgin MonoFlo DeIonizer costs far less to buy and operate. It requires but little space — is simple in operation — cuts regeneration time and rinse water requirements — and has other notable Elgin features which make it today's outstanding deionizing equipment.

Similar in design and function, but utilizing different ion-exchange resins, the Elgin Ultra-DeIonizer also *completely removes silica and CO_2.*

These DeIonizers incorporate the famous Elgin "Double Check" manifold assembly which permits the use of a deeper bed of ion-exchange resins without loss — giving a marked increase in demineralized water output.

ELGIN ECONOMICAL WATER CONDITIONING SINCE 1908

Write today for detailed information

ELGIN SOFTENER CORPORATION

138 North Grove Avenue, Elgin, Illinois

Water Conditioning Since 1908

Edited specifically for the plant engineering group—the executives and engineers responsible for the generation, transmission, distribution and utilization of energy in its various forms for power, processing and engineered services

INDUSTRY AND POWER

The Magazine for the Plant Engineering Group

VOLUME 59 **OCTOBER, 1950** NUMBER 4

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Established May, 1920

Member Controlled Circulation Audit and National Business Publications, Inc.

Distributed Exclusively to Buyers of Equipment in America's Best Plants

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INDUSTRY and POWER, including INDUSTRIAL POWER, is published monthly at St. Joseph, Michigan. Accepted under the act of June 5, 1934, authorized August 31, 1942.

Cover Illustration

Training demonstration staged by the Pennsylvania Power & Light Company showing a 1½-in. spray nozzle being used to extinguish an oil fire.

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CONTROL of Scale begins with pH and PHOSPHATE DETERMINATIONS

BOILER WATER COMPARATORS

Model P contains either High or Low Phosphate Comparator. Model W contains same plus 3 pH slides (pH 7.2 to 8.8); (pH 8.6—10.2); (pH 10—11.6) and accessories.

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Makes Determinations Fast and Easy

Because Taylor Boiler Water Comparators bring accurate pH and Phosphate determinations down to a simple one or two minute operation, they have become the accepted standard tool throughout industry. Taylor sets give maximum convenience since all liquid color standards necessary for a determination are enclosed in a rugged plastic slide. There are no fragile single standards to handle. You are assured of maximum accuracy because all the Taylor Liquid Color standards carry an unlimited guarantee against fading.

The low cost, extreme accuracy with simplicity of operation make Taylor Comparators the ideal instrument for all plants — large and small.

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WRITE FOR THIS VALUABLE REFERENCE BOOK — FREE —

"Modern pH and Chlorine Control" covers theory and practice in 34 basic industries. Also tells how Taylor Sets can make your job easier . . .

W. A. TAYLOR AND CO.
7306 YORK RD. • BALTIMORE 4, MD.

Apropos of—

A New Reader Service

ON pages 147 and 148 you'll find the planned, classified advertising section which is making its debut with this issue. This new reader service has been designed to give special, display emphasis to advertisements for: Rebuilt Machinery—Used Equipment; Engineering Services; Business Opportunities; and Positions Wanted.

As shortages of new equipment increase, because of re-channeling of steel and other essential materials, sources of rebuilt and used equipment become increasingly important to your production curve. As war production, draft and enlistments decrease our national supply of manpower, you'll appreciate more and more the advertising under "Positions Wanted". You'll always find it helpful, as well as profitable, to utilize the services of engineering firms. As our classified advertising section grows and develops, it will contain a comprehensive listing of their specialized services available to you.

But, as any other market-place, this classified advertising section works two ways. Through this section you can gain "spotlighted" attention of important personnel in the Plant Engineering Group who are in the position to buy your services or excess equipment. Through the classified section, you can contact 36,752 industrial units which have been carefully selected as the prime market for exactly the equipment and services you use in your own plant.

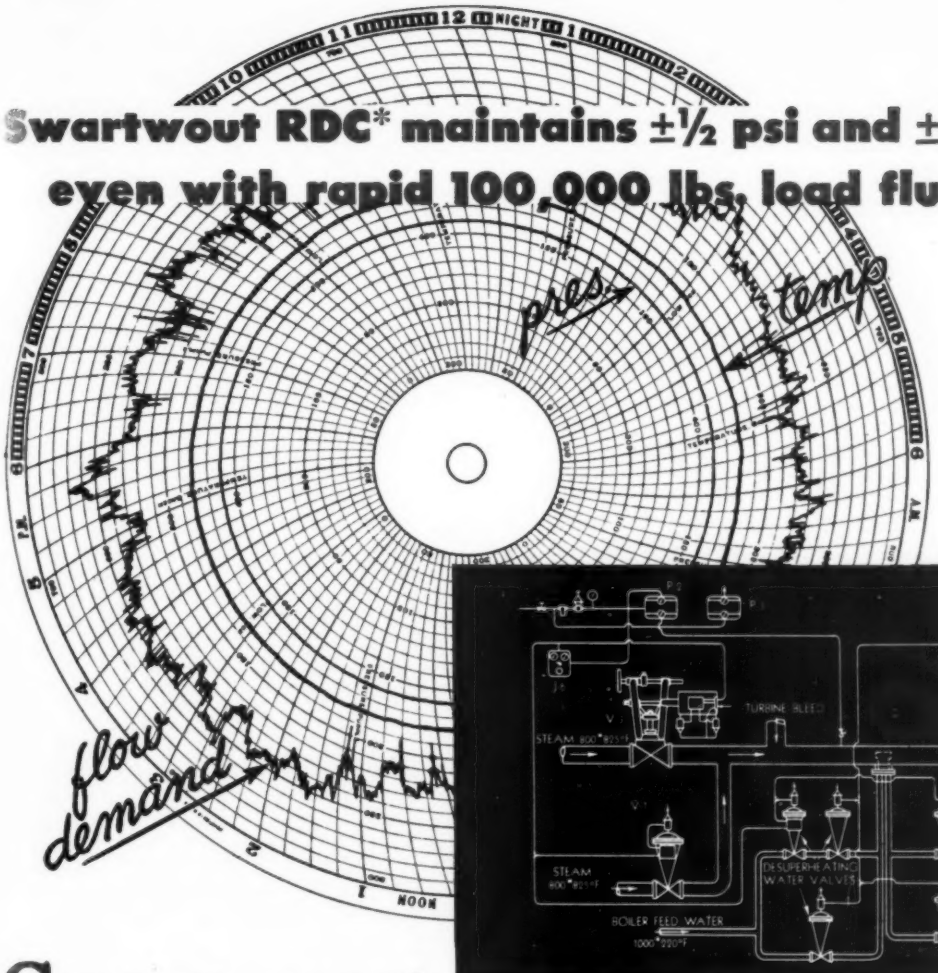
Usefulness of this service has been enhanced through a very low and reasonable advertising rate. By contracting for 96 inches of space, for example, to be used during a twelve month period, the cost is only $11.00 per inch. A further projection of these same figures gives you a surprisingly low cost of less than 30c per inch of space to reach 1,000 *industrial units.*

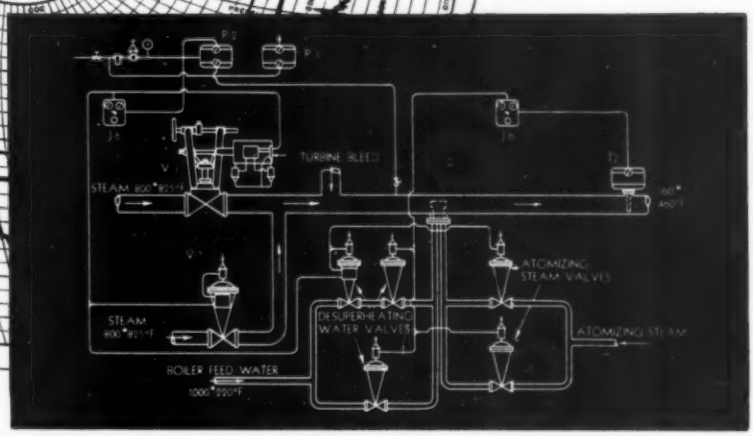
If you want complete information on classified advertising in I&P, address your inquiry to Classified Advertising Department, INDUSTRY AND POWER, St. Joseph, Michigan. A regular check through these classified ads will pay you big dividends in savings as well as help you solve many a procurement problem in months to come.

L. E. Aiss

Publisher

Swartwout RDC* maintains ±½ psi and ±3°F control even with rapid 100,000 lbs. load fluctuation

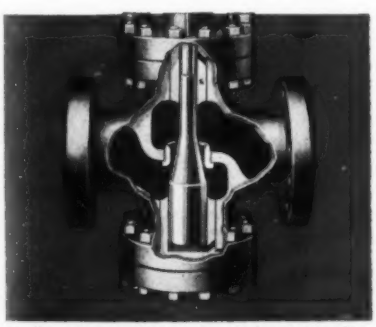




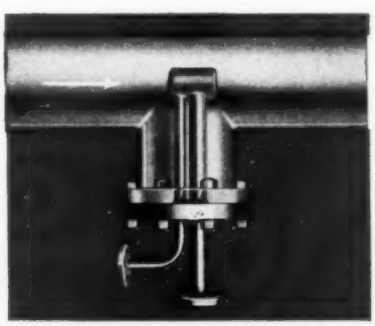
Swartwout

POWER PLANT EQUIPMENT

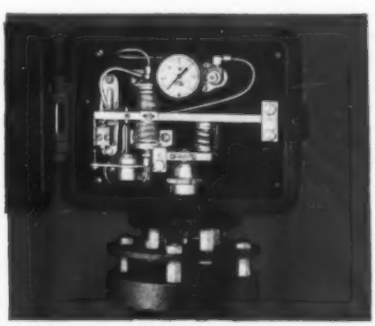
1 Swartwout RDC* system – Reducing, Desuperheating and Controls – handles fluctuating make-up load of up to 250,000 lbs. steam/hr. in a large Eastern paper mill. Initial conditions, 800 psi and 825°F; required final conditions, 160 psi and 460°F. Chart shows how Swartwout RDC system holds pressure to ±½ psi, temperature to ±3°F from minimum to maximum loads.



2 Swartwout V-1 valve *(above)* handles first 50,000 lbs. of load; V-3 then cuts in to handle 200,000 lbs. additional load. Valves reduce pressure from 800 to 160 psi without turbulence, vibration or undue noise. Correct design of disc, seat and throat eliminates high-velocity impingement and other destructive forces common to conventional reducing valves.



3 Swartwout steam atomizing desuperheater drops live steam temperature from 825°F, and varying extraction temperatures, to 460°F without pressure loss. Smooth-finished nozzle passages disperse atomized water outside head so that no erosion occurs. Narrow-angle atomization prevents thermal strains or cracks in piping, eliminates need for pipe liners.



4 Swartwout T2 direct-contact master control with reset for load compensation, sends temperature-proportional air-loading pressure through J-6 manual-automatic selector panel. Response to temperature change, within fraction of a second, assures precise temperature control regardless of load fluctuation or time lag.

A-2788

SEND FOR BULLETINS S-21-E, S-22-C, S-198 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

new equipment and developments

You can easily get more data on these new equipment and development items. Use the handy, postage-free order cards on Page 37. Just list the key numbers of the descriptive paragraphs in the spaces provided on the card and mail

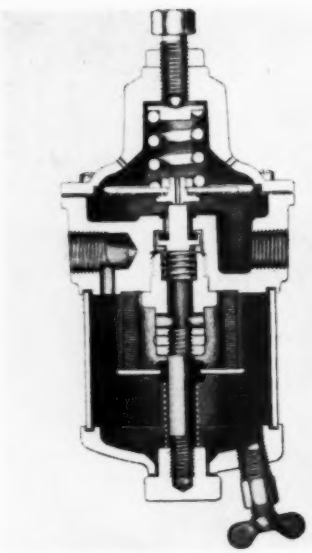
301—ADJUSTABLE HEATER FEATURE IN THERMOSTAT

Perfex Corp. is now manufacturing thermostats with built-in adjustable heaters. This feature eliminates the nuisance of carrying a variety of heater coils or plugs in order to have the proper heater in the thermostat.

Adjustments ranging from .4 to .8 amps, that would cover almost every installation, are quickly and simply made by turning an adjusting screw on the back of the thermostat. After the adjustment is made, the automatic dial takes over to provide the desired even temperature.

302—AIR FILTER HAS THREE FEATURES

Conoflow Corp. has developed a combination regulator, filter and dripwell in a



single compact unit. Constructed entirely of brass and stainless steel, this device provides maximum resistance to corrosive atmospheres frequently encountered in industrial processing plants and around seaboard areas. Capacity is approximately 25 cfm. Design utilizes a side mounted drain cock permitting horizontal as well as vertical mounting. Filter medium is phenolic resin—impregnated cellulose capable of removing oil and water and particles down to 40 microns. Three ¼ in. NPT taps permit multiple reduced pressure connections and integral pressure gage mounting. Available in reduced pressure ranges of 0-25, 0-50, 0-125 psig.

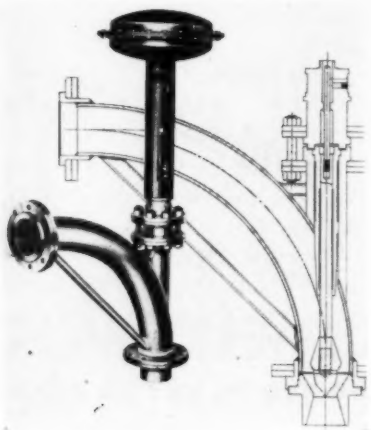
303—FIRE ALARM OPERATES ON TEMPERATURE RISE

The Autocall Co. has announced the development of an electric trip fire alarm box, which may be automatically actuated by the operation of rate-of-rise or fixed-temperature thermostats, or manually tripped by breaking the glass. Designated as MA-ET, it is especially recommended for industrial plants, where several circuits of thermostats are used for automatic fire detection. When tripped, four complete rounds of coded alarm are transmitted through audible signals of the fire alarm system. Personnel hearing the code are enabled to proceed directly to the scene without delay.

Mechanism is a pre-wound spring-driven type. When tripped, a target drops into view behind a window, and a neon light glows until the box has been reset. Resetting is quickly and easily accomplished by opening the door, replacing the glass (if necessary) and winding the mechanism. When the door is opened after an alarm it cannot be closed until the box is fully reset.

304—LONG SWEEP ANGLE VALVE HANDLES SLURRIES

The Hammel-Dahl Co. announces the 7000S series flow-tested long sweep angle valves designed primarily to produce the minimum turbulence in slurry service where solids in suspension tend to plug conventional type control valves. Valve body is a long radius bend. The seat has a venturi throat that assures the minimum turbulence in the seat section. These valves can be provided in any size from 2 to 6 in. The standard spring range is 3-15 psi. Spring ranges for high pressures can be provided.



305—LIQUID SAMPLE COOLER FOR BOILER FEEDWATER

A liquid sample cooler for cooling boiler and boiler feedwater samples has been announced by Worthington Pump and Machinery Corp. The unit is suitable for cooling samples required for controlling chemical and refinery processes and for general laboratory use. It is a shell and tubular coil type stainless steel heat exchanger of all welded construction designed so that the connections are external to both cooling coil and jackets.

Operation is on the counterflow principle, which makes possible the cooling of liquid samples to temperatures approaching those of the inlet cooling media. Designed for 1500 psi and temperatures of 600 F on the cooling coil side, and 150 psi on the stainless jacket side, it has an outside diameter

(Continued on page 12)

Prevent Return Line Corrosion

with

FILMING AMINES

HERE'S AN exciting *new* development in the Water Conditioning Field!

Corrosion of steam and condensate return lines is a serious problem to most industrial plants. Such corrosion is caused by the presence of carbon dioxide and oxygen. Up to now, it has been the usual practice to neutralize the carbon dioxide. However, the high cost of this neutralization method has limited its application. And, no protection against oxygen corrosion is assured.

Betz Laboratories have developed a new, advanced process for the prevention of return line corrosion employing *octadecylamine*. This material *does not* neutralize the carbon dioxide. Instead, the amine is adsorbed on the metal surfaces in a monomolecular non-wettable film which acts as a barrier between the metal and the condensate, protecting against both oxygen and carbon dioxide attack. The monomolecular film does not increase in thickness with continued treatment. Results? As high as *99 percent reduction* in corrosion rate has been achieved!

Let a Betz Field Engineer show how you can cut costs in your plant with the use of filming amines. Write today! There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Pa. In Canada: BETZ Laboratories, Limited, Montreal 1.

Send for Betz Technical Paper #120, "How Filming Amines Prevent Steam and Return Line Corrosion".

*U. S. PATENT 2,460,259

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

NOW

Big boiler advantages "wrapped up" in NEW COST-SAVING B&W SHOP-ASSEMBLED UNIT

Here at last is the ideal combination for efficient, low-cost "packaged" steam: the new B&W Integral-Furnace Boiler, Type FM. It combines the many advantages of factory-assembled boilers with the service-proved economies of B&W Integral-Furnace construction. It's delivered fully-equipped for immediate operation.

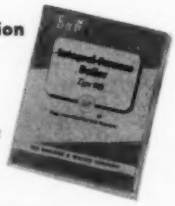
Of prime importance is the fact that this new B&W boiler embodies design, construction, and operating features that have made larger capacity Integral-Furnace units such a heavy favorite among industrial plants and central stations.

Small and medium size plants, institutions, and commercial establishments will find this new unit the ultimate in low-cost heating and process steam-generation from 3,000 to 35,000 lb. per hr. at pressures to 250 psi. Large plants, too, where space and load characteristics warrant, may profitably consider several packaged boilers instead of a single "tailor-made" installation.

Engineered, designed and built under a single responsibility, the new Integral-Furnace Boiler, Type FM, is backed by the same tradition of service satisfaction that has made B&W a by-word in low-cost steam generation for over 80 years.

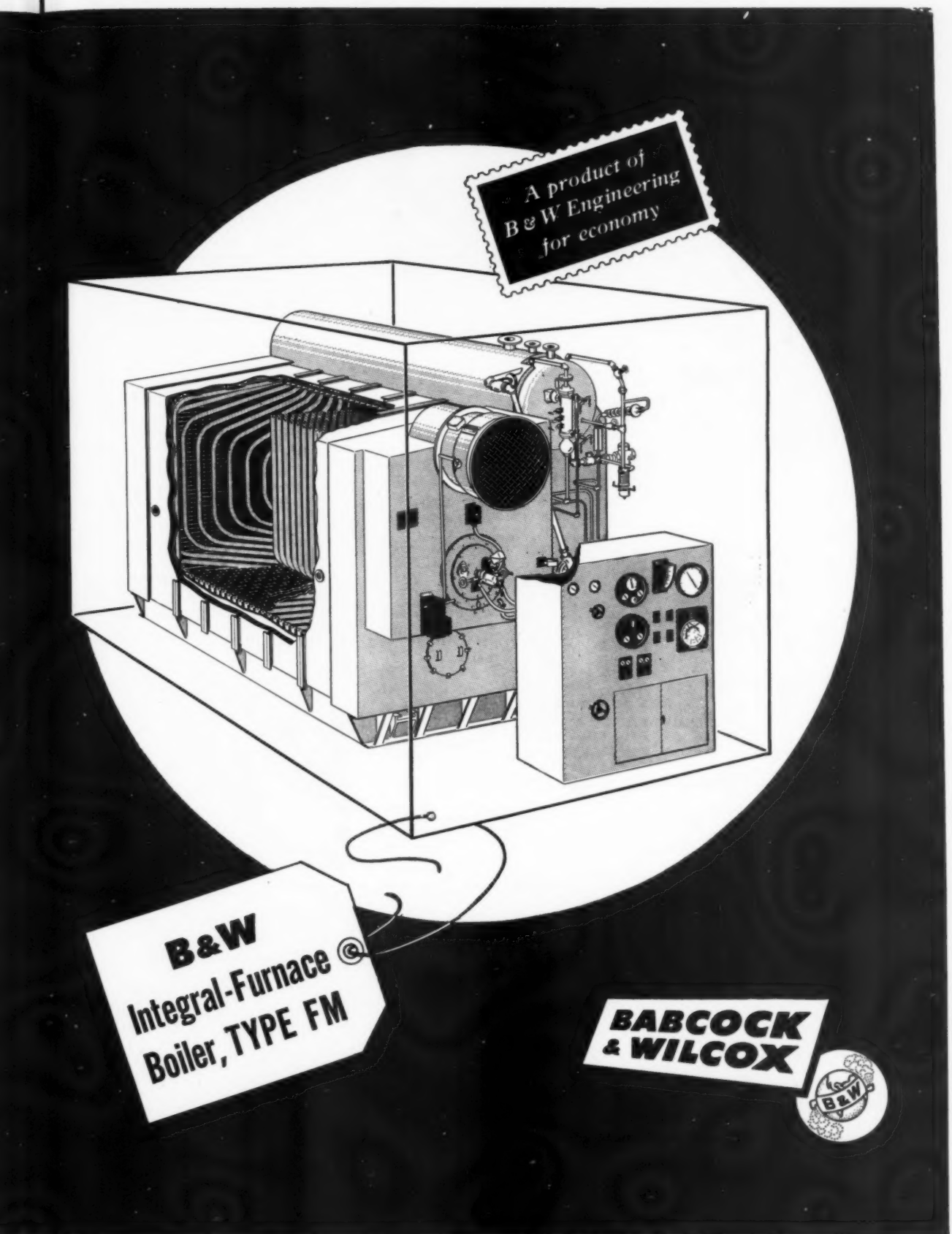
cost-saving features of the new B&W Integral-Furnace Boiler, TYPE FM

- Saves Erection Time and Cost
- Meets Wide Range of Services
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and /or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation



Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation.

The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

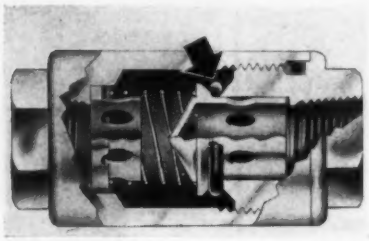

A product of
B & W Engineering
for economy
B&W
Integral-Furnace
Boiler, TYPE FM
BABCOCK
& WILCOX
B&W

(Continued from page 8)

of 3⅜ in. and an overall length of 11¼ in. Made in capacities of ¼ and ½ gpm.

306—CHECK VALVES OPERATE BETWEEN 0 AND 3000 PSI

James-Pond-Clark, Mechanical Engineers, have announced leakproof circle seal check valves available as standard catalog items in a full range of sizes from ⅛ to 1 in. NPT. Two models are included, standard, 0 to 3000 psi and very low pressure, 0 to 1 psi. Both are poppet type using an "O" ring seal. Absolute sealing, minimum flow resistance and leakproof dependability for pneumatic and hydraulic systems are featured. Opening pressures are as low as 1 psi differential



in the standard pressure types and 4 in. water column in the low pressure types. Operating principle utilizes a synthetic rubber "O" ring between conical surfaces on the poppet and valve housing. As the line pressure works against the outer periphery of the "O" ring, increased line pressure greatly increases the sealing pressure.

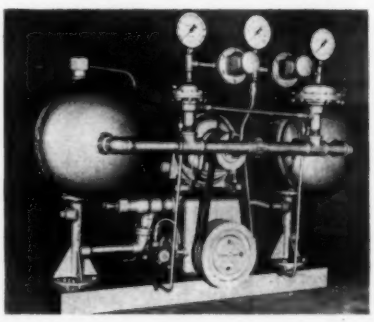
307—ELECTRONIC TACHOMETER GIVES ACCURATE DATA

The Potter Instrument Co. announces a high speed electronic counter tachometer for high accuracy revolution and frequency measurements. The instrument totalizes the count measured during a time interval of 0.6 sec. This reading is displayed on a direct-reading, four-digit electronic counter using ten neon glow lamps for each digit. Measurement of frequencies up to 100,000 cycles per second with an accuracy of plus or minus 1 cycle is possible. In addition the unit includes a count rate meter, which can be used when the unknown frequency source

is being adjusted. This type of indication reflects instantaneous changes and is useful when the source of frequency must be manually adjusted to a specific point. Ideally suited for high speed turbine, engine and motor speed measurements. It can be supplied with electro-magnetic or photoelectric pick-up devices for detecting the speed without physical contact.

309—MOLDING PRESS HAS ZERO TO 1000 PSI RANGE

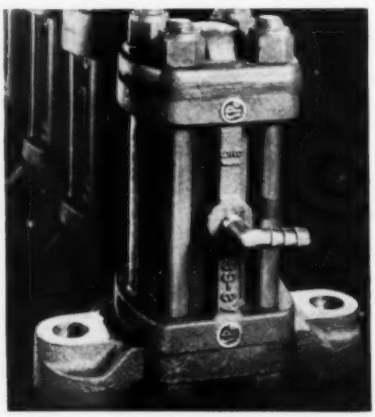
Simplicity of design and flexibility of control are points claimed by Oracle Engineering & Sales Corp. of the Rialto power source for hydraulic molding presses. Heart of the pumping unit is a unique bypass sleeve, actuated in and out of pumping position by a snap action regulator control valve. Two separate pumping sections develop individual pressures providing for low pressure rapid advance volume and high pressure liquid for "dwell time." By regulating air pilots both low and high pressures may be individually selected, providing line pressures from 0—6000 psi and permitting the use of a simple operating valve for press control. Available in 6 sizes to pump water, oil or other mediums.



For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

310—AIR VIBRATOR PREVENTS ARCHING

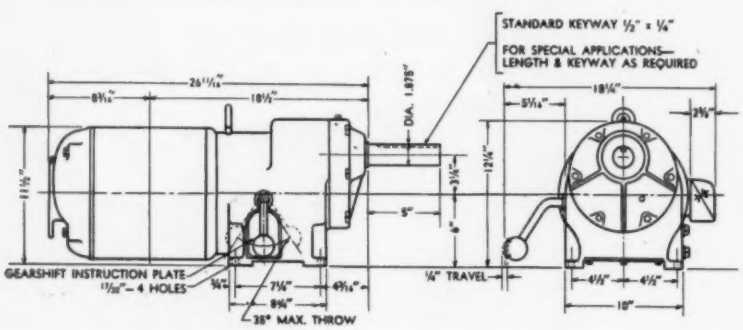
Spo Inc. has announced the development and availability of series 81 pneumatic vibrators for intermittent or continuous operation on all types and sizes of storage bins or hoppers. Powerful, hammer-like impacts prevent arching-over or plugging and assure a steady flow of material through chutes. A special, corrosion proof, bronze alloy cylinder liner in the vibrators assures full-power start, high-speed operation and maximum service life. These units are



available in 1⅝, 2 and 2½ in. piston dia sizes and are equipped with a ¼ in. rigid or swivel type straight or ell connector for hose attachment.

308—GEAR MOTOR DRIVE HAS 123 TO 1140 RPM RANGE

The Lima Electric Motor Co. has added a 5 hp 1200 rpm selective-speed gearshift drive to their line. Designated as Type R3AC, the unit incorporates both primary and secondary gear reductions. It is designed to individually motorize and drive machinery of various types that require a low range of selective operating speeds, combined with high radial load capacity. This four-speed sliding gear transmission has selective primary gear ratios of 4.15, 3.15, 1.85 and 1.00 to 1, and a secondary gear train with optional ratios of 2.25, 2.06, 1.89, 1.74, 1.60, 1.48, 1.36, 1.26, 1.17, 1.08, or 1.00 to 1, providing a choice of output speed combinations from 123 to 1140 rpm. Overall dimensions are 31 11/16 in. long, 12 1/4 in. high and 18 1/4 in. wide. Full-rated horsepower is delivered in each of the four speeds. Both constant-torque and constant-horsepower two-speed motors are available on these units giving the increased flexibility of additional speeds.

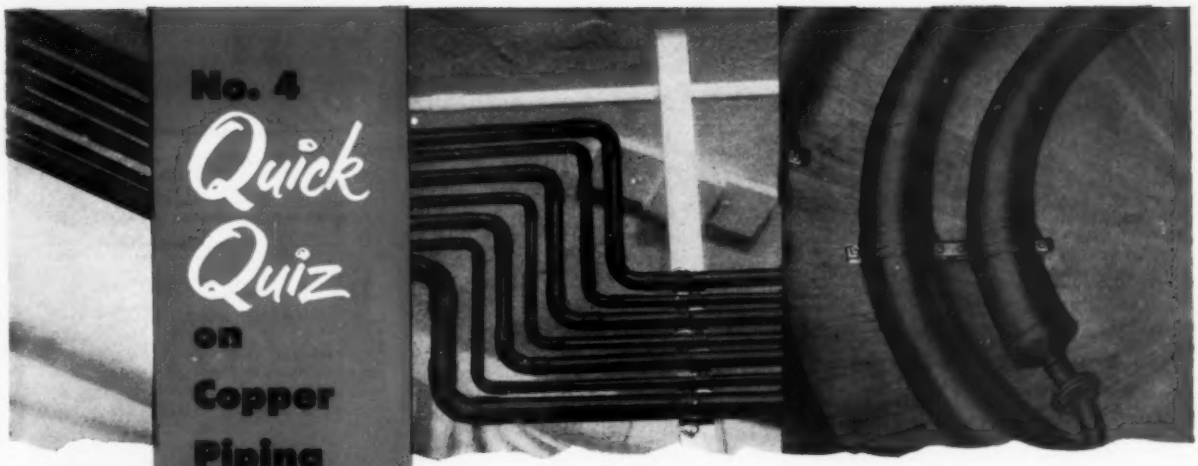


311—GREASE GUNS ARE OPERATED ELECTRICALLY

Two high pressure electric grease powerguns, of 25 and 40 lb capacity, are available from Alemite Div. of Stewart-Warner Corp. Model 7170-R, 25 lb, will deliver 14 oz of light or medium lubricant per minute at 70 F. It will handle all greases that seek their own level and develops 5,000 psi. Equipped with 115-v 60 cycle universal motor and heavy duty switch, which automatically shuts off motor when pressure is built up. Complete with seven ft of ¼ in. ID high pressure hose, ball bearing Z-type swivel and control valve. Rear wheels are 8 in. front wheel 4 in., available in rubber or steel.

Model 7175-R, 40 lb, handles all types

(Continued on page 14)



No. 4 Quick Quiz on Copper Piping

Q Does copper tubing lose less heat than iron pipe does?

A Yes. Because of its smooth, reflective surface, heat losses from exposed ANACONDA Copper Tubing due to combined convection and radiation are approximately only half as great as the heat loss from a black iron pipe of the same nominal size.

Q Why is copper tube better for carrying refrigerants?

A ANACONDA Copper Refrigeration Tubing cannot rust and is not attacked by freon or methyl chloride; there is less danger of scale forming and clogging tubing or valves; and leakproof connections are easier to make with copper tubing.

Q Is there more or less danger of bacteria and fungi propagating in copper tubing?

A Less, because the smooth interior and absence of pockets in ANACONDA Copper Tube and Fittings offer less opportunity for lodgement and development of bacteria and fungi.

Q What other undesirable accretions or deposits are prevented or minimized in copper tubing?

A There are many: paper slime, beer stone and milk stone are examples of troublesome industrial deposits in piping which are prevented or minimized in ANACONDA Copper Tube.

Q How can I get advice on copper tubing for my application?

A

Anaconda engineers will gladly advise you without obligation. A special booklet, Publication C-24, containing much useful information is also available. Write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

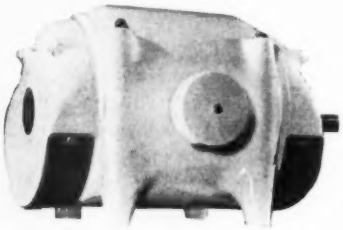
For better Piping... use **ANACONDA®**
COPPER TUBES

(Continued from page 12)

of grease, fibrous, heavy or light. It has helix arm and worm gear priming, and delivers 5½ oz of heavy fibrous lubricant per min at 70 F. Develops 5,000 psi and has heavy duty 115-v 60 cycle universal motor with switch, which automatically shuts off motor when maximum pressure is built up. Complete with 10 ft of ⅜ in. ID high pressure hose, ball bearing Z-type swivel and control valve. Available with 8 in. rear and 4 in. front wheels, of steel or rubber, or with 8 in. front and 16 in. rear wheels of steel. Where stationary or truck mounting is desirable, Model 7175-R is available less wheel and hose assemblies.

312—MOTOR HAS SANITARY FEATURES

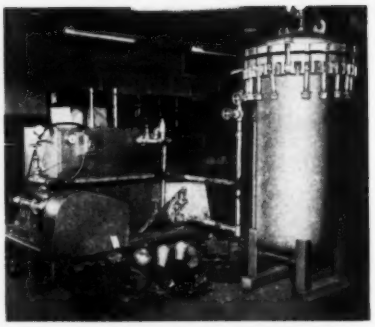
Screened, splashproof motor for sanitary applications has been developed by engineers of U. S. Electrical Motors Inc. This model, Type CP, is equipped with screened ends



with the openings located underneath so that water cannot intrude. Screened vents permit full ventilating. Range is from 3 to 7½ hp. Fully streamlined, the motor is finished in baked white enamel and meets all sanitation codes.

313—PRESSURE UNIT SEALS POROUS CASTINGS

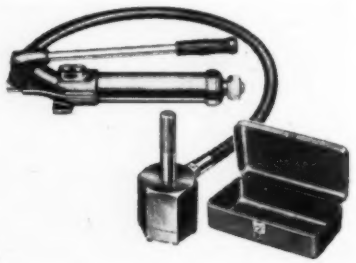
High pressure equipment developed by Tincher Products Co. permits porosity- elimination treatment of small cast parts in bulk. Principal use is for reclaiming porous castings that must withstand liquid and gas pressures. The device treats all internal and external surfaces simultaneously. Cast parts are placed in a wire basket, which is



lowered into the tank and securely covered. A sealing agent is introduced, and the high pressure created forces the sealer into all pores and voids in the casting. The unit is designed to treat small valve and pump housings, hydraulic brake cylinders, fittings and other cast parts of similar characteristics.

315—PUMP OPERATED CONDUIT DRAW BAR

Pump operated Ohio draw bar pulls ½ to 4 in. size conduit holes without manual exertion; eliminates danger of short-circuiting adjacent wires and will not warp, break, tear or distort metal according to the Patterson Equipment Co. A pressure of 30 psi on handle produces 12,000 psi on cutting surfaces, and a clean, smooth edge conduit hole is cut in less than a minute without accident hazard to operator or equipment. The device is fast, flexible, simple to operate. It performs efficiently in any desired position with pump at vertical or horizontal angles. Cut-

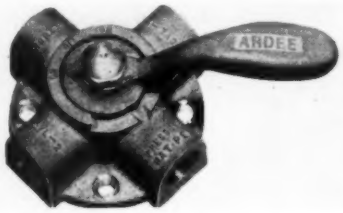


ters are standard for hand operated knockout punches. The unit is completely assembled and packed in a compact, readily portable metal carrying case.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

316—FOUR-WAY CONTROL VALVE HAS SLIDE FIT

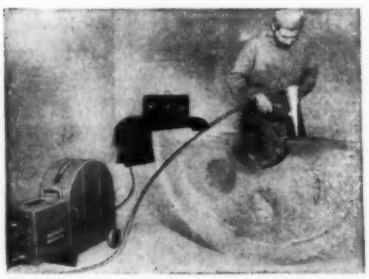
Barksdale Valves are marketing an inexpensive manual 4-way valve to control 150 psi air pressure and handle liquid pressures up to 1000 psi. Available in pipe sizes



from ¼ to ¾ in. A tubular sealing member slides over the peripheral surface of a rotor, maintaining intimate contact during operation of the valve. Pipe scale and foreign material in the line cannot lodge between the sealing surfaces, due to the wiping action of the sliding seal. Valve bodies are furnished in aluminum or brass, and the tubular sealing members are molded of various resilient materials suitable for the service requirements. The controlled degree of softness assures a tight seal against the curvature of the mating surface.

317—HANDGUN WELDS UNDER GRANULAR FLUX

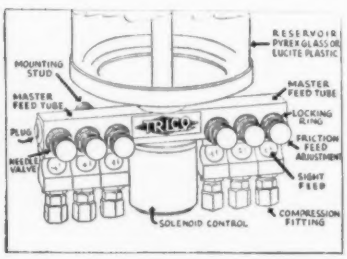
Manual Lincolnweld ML-2 unit for the Hidensity submerged-arc welding process is announced by the Lincoln Electric Co. It is connected in a few minutes to any stand-



ard Lincoln SAE 600 or 900 amp generator. Mechanism automatically feeds wire at a preset arc voltage from the reel through the conductor cable and welding gun to the work. The gun also delivers the inorganic granular flux, completely covering arc and crater. Gun is moved either by hand or by mechanized carriage.

314—SOLENOID CONTROLS MULTIPLE OILER

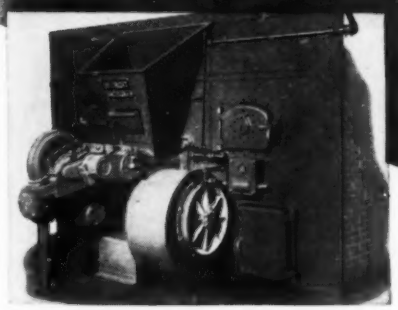
Centralized system of lubricating 1 to 20 bearing points on machine tools and other equipment is announced by Trico Fuse Mfg. Co. Oil is fed by gravity from large reservoir through individually adjustable needle-valves to the various bearings. When solenoid, located directly below reservoir, is energized oil feeds to all lines. Can be operated from a current outlet or connected directly across motor starting switch.



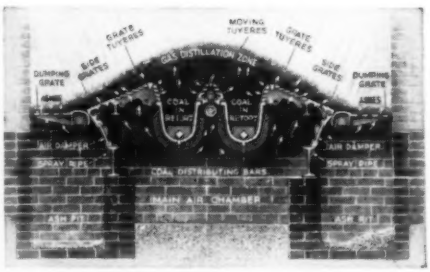
318—FLOW REGULATOR HAS ADJUSTABLE FEATURE

Waterman Engineering Co. has developed an adjustable flow regulator for cylinder

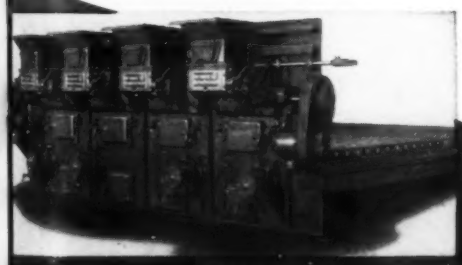
(Continued on page 16)



DETROIT UNISTOKER Single retort underfeed with Adjustable Coal Feed Control.



DETROIT DOUBLE RETORT A multiple retort—side cleaning underfeed for medium sized boilers. No basement required for ash removal.



For any steam generator including package types use DETROIT STOKERS

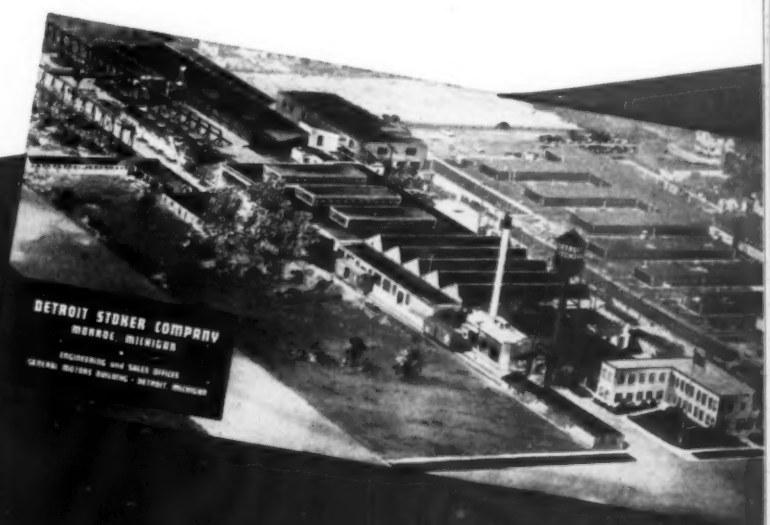
We build stokers adaptable to any type or make of boiler or steam generator. No matter what you are considering we can furnish the ideal stoker—the one that fits the furnace and is best suited to your operating conditions.

Detroit Stokers are successfully operating in thousands of boilers of different types, from firebox heating boilers to large steam generators of over 300,000 pounds of steam per hour, capacity. They are installed in private and public institutions, buildings, industrial and power plants, here and Abroad.

Assembled and Inspected In Our Plant Before Shipment

Each stoker that we design and build is assembled by experts in our plant and carefully inspected prior to shipment. You can't go wrong with Detroit.

Built to outlast the boilers that they serve, Detroit Stokers give you the best, most economical firing method for your needs. An informal discussion with one of our Engineers will cost you nothing and might save you a lot. May we hear from you?



DETROIT STOKER COMPANY

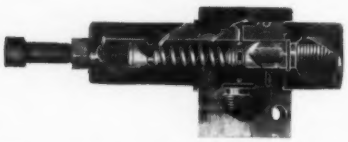
DETROIT STOKERS

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities . . . Works at Monroe, Michigan

(Continued from page 14)

speed control. This device gives a constant rate of flow regardless of pressure fluctuations or change in working resistance at any setting within the adjustable range. Adjust-



able range is 50% of the calibrated flow rate in gpm. Available for hydraulic systems with operating pressures to 3000 psi. Line sizes are ¼, ⅜, ½ and ¾ in. NPT (dry seal). Maximum controlled flow is 16 gpm.

319—STEAM TRAP HAS BUILT-IN STRAINER

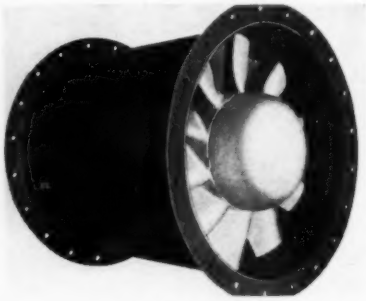
Armstrong Machine Works is making another small inverted bucket steam trap, which has a built-in brass strainer. Known as the No. 881, this side-inlet, side-outlet trap is used for draining smaller sized equipment producing relatively small amounts of condensate. The built-in strainer feature elimin-

ates separate strainer, extra fittings and installation labor. Available for ½ or ¾ in. pipe connections; 250 psig operating pressure; 769-1060 lb/hr continuous discharge hot condensate capacity; 7 1/16 in. height; 5 in. dia, 6 lb weight; cast semi-steel body and cap; and 18-8 stainless steel bucket.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

322— LOW HORSEPOWER INPUT DUCT FAN

Propellair Div. of Robbins & Myers, Inc. announces the addition of two vanaxial type, medium pressure, propeller fans to its line of commercial and industrial ventilating



equipment. Designed for ductwork applications, both operate on low horsepower input and possess the ability to work quietly over a wide pressure range. Easily installed in standard 20 and 25 in. dia duct systems, the units are equipped with open-ventilated, ball bearing, 40 C rise, standard NEMA Robbins & Myers, Inc. foot-mounted motors. Type VCDD are direct driven units, constructed with the motor inside the airstream. Type VCS belt-driven units are recommended for installations in which corrosive or inflammable fumes, dusts, or vapors must be considered.

323—SILICONE RUBBER RESISTS HEAT

The Stalwart Rubber Co. can now furnish gaskets, sleeves, washers, channels, seals, tubing and other molded, extruded, punched

and lathe or die-cut rubber parts in quantity fabricated from Silicone 161 rubber compound. This material has a tensile strength of from 470 to 520 psi, elongation of 110 to 160 per cent and a very high specific gravity of 2.1. It will not become brittle nor crack after long exposure to air, ultraviolet rays or ozone. Parts will not turn to carbon despite extreme heat, and they can be used to replace metal constructions.

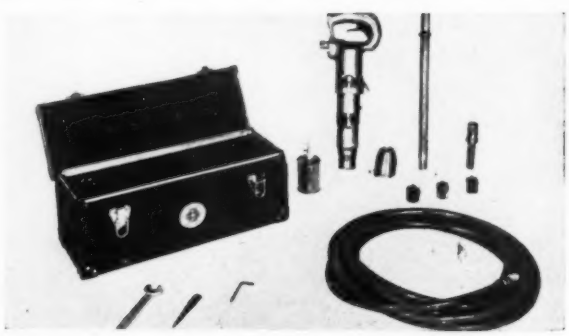
324—PORTABLE GRINDER OPERATES ON D-C OR A-C

Portable heavy duty 6 in. grinder has just been announced by Skilsaw, Inc. Engineered for continuous operation, Model 142 is ideal for grinding castings, wire brushing or buffing and polishing metal surfaces. It prepares welding surfaces and grinds down weld beads; cuts off pins, bolts, studs and rivets; and removes rust, scale and paint. Features include a molded covered rear

(Continued on page 125)

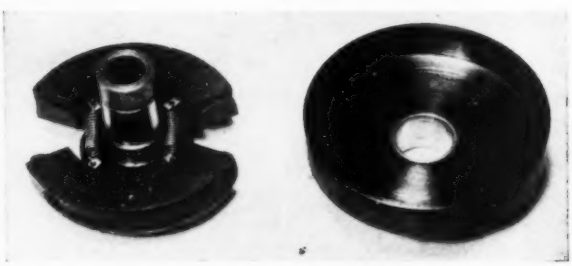
320—UTILITY DRILL COMES IN CARRYING CASE

Lightweight utility drill for plant maintenance has just been announced by Gardner-Denver Co. that comes in a handy carrying case with a complete kit of drill accessories. Included are a 14-in. drill steel, three assorted-size rock bits, a star drill adapter and 25 ft of air hose. The unit designated as S17, is said to be a full-fledged, self-rotating pneumatic hammer drill that weighs only 19 lb. It is a handy tool for placing anchor bolts, running conduit, cable and pipe. Either concrete, brick or stone can be drilled with a standard drill steel. Adapter furnished with the drill accommodates standard star drills. A special stop-rotation feature converts the S17 to a lightweight chipping hammer or pick. The hand-formed "D" handle is convenient to hold. A "safety first" trigger throttle—with partial feed position for easy hole starting—contributes to the operator's safety.



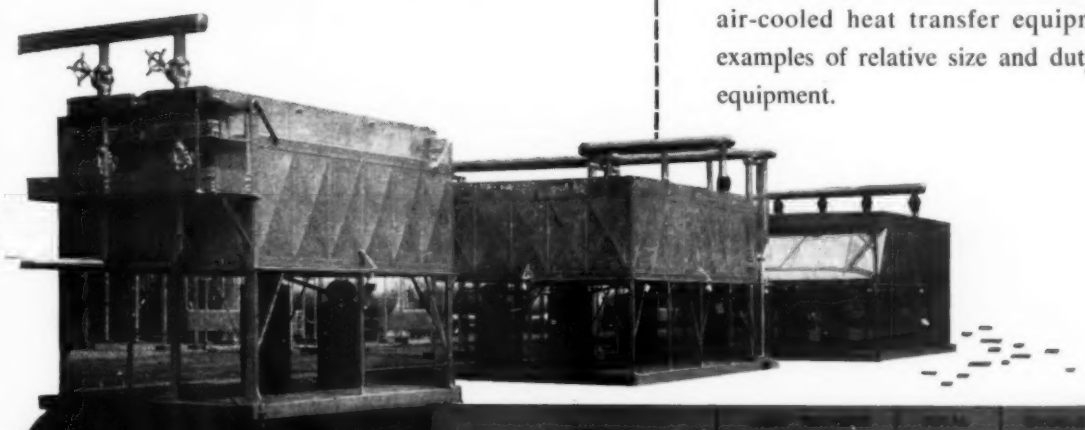
321—FRICTION CLUTCH CAN OPERATE AT 850 F

Armstrong Products Co. is now mass producing a low cost, centrifugal clutch adaptable for both electric motors and internal combustion engines of ½ to 6 hp. This general purpose clutch was tested under operating temperatures of 850 F without damage to friction block or decrease in operating efficiency. During these tests no excessive slippage was noted, and it can be operated in either direction. Friction blocks are easily and inexpensively replaced on the job. These centrifugal clutches will be manufactured in three sizes at the present time to accommodate the small motor field. However, special designs will be made to fit specifications.



Here are 15 TYPICAL APPLICATIONS for FIN-FAN AIR-COOLED Heat Exchanger Equipment

For many years, Fin-Fan Air-Cooled Heat Exchangers have proved their worth by giving reliable, economical service in many and varied applications. The Fluor Corporation, Ltd., and Griscom-Russell Company, pioneer-partners in the air-cooled heat transfer field, offer the following to show the large variety of practical applications for air-cooled heat transfer equipment and examples of relative size and duty of such equipment.



SERVICE	(BTU/HR.)	H.P.	SPACE
GAS COOLING			
Natural Gas After-Cooler	13,920,000	80	46' x 25'
Manufactured Gas Cooler	11,165,000	50	23' x 21'
Natural Gas After-Cooler	3,400,000	15	11' x 21'
Natural Gas Inter-Cooler	7,890,000	40	23' x 21'
VAPOR CONDENSING			
Reflux Condenser	18,407,000	90	48' x 25'
Primary Condenser	4,652,000	40	11' x 25'
Still O.H. Condenser	4,875,000	34	16' x 21'
Debutanizer Condenser	11,930,000	60	23' x 25'
Still Reflux Condenser	39,110,000	60	46' x 25'
Steam Condenser	87,300,000	300	138' x 31'
Steam Condenser	2,880,000	10	10' x 6'
LIQUID COOLING			
Vegetable Oil Cooler	628,000	15	6' x 17'
Absorption Oil Cooler	14,915,000	100	32' x 17'
Quenching Oil Cooler	1,665,000	50	23' x 25'
Amine Solution Cooler	19,300,000	175	38' x 25'
Stabilized Crude Cooler	125,100,000	700	315' x 25'
Jacket Water	2,400,000	5.5	16' x 12'
Jacket Water	28,800,000	100	70' x 24'

A new 8-page bulletin on Fluor-GR Fin-Fan Heat Exchangers is now being prepared. Write in and reserve your copy by post card or letter.

Why Fluor-GR Fin-Fans Lead The Field

The Fin-Fan Air-Cooled Heat Exchanger is unique in its development and manufacture. It is the result of the engineering skill of *two* companies, *each* long recognized as leaders in their respective fields. It combines Fluor's experience in the design, fabrication and field erection of air-moving systems with Griscom-Russell's experience in heat transfer.

Success is evident in repeat orders. Since 1941, hundreds of Fluor-GR Air-Cooled Heat Exchangers have been installed throughout the world . . . nearly 50% have been repeat orders!

FLUOR

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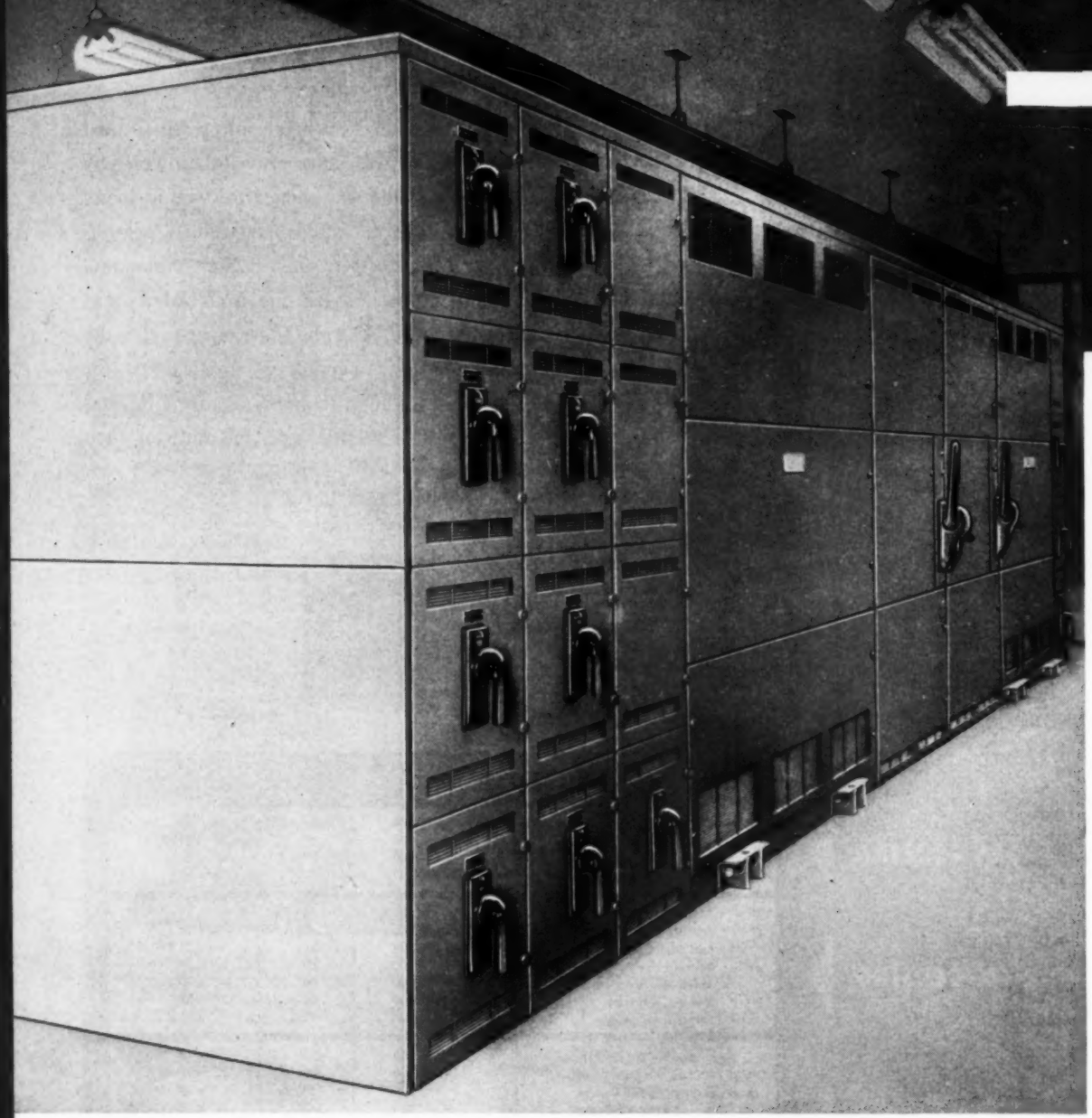
ENGINEERS • CONSTRUCTORS • MANUFACTURERS

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif., *Offices in principal cities in the United States*
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.I., England



Here is a typical I-T-E indoor Unit Substation with air cooled transformers. Substation arrangement puts primary load break interrupter switches *and* transformers in the center. As load grows, addition of low voltage switchgear to either end is simple and inexpensive.

Uniform appearance of the structure and symmetry of enclosing panels are consistent with the operating excellence of I-T-E switchgear.

Only at I-T-E is *all* of the unit substation enclosure designed, manufactured and assembled in the *same* plant of one division of the company. Quality control is consistently maintained and coordination is assured. Results are simplified installation and improved appearance for *your* plant.

There's an I-T-E Field Application Engineer near you to help you in planning for the future with sound engineering information about I-T-E Unit Substations. Call him today!

I-T-E

1 **REDUCED CONDUCTOR INVESTMENT AND MAINTENANCE**

I-T-E Unit Substations distribute low voltage a-c energy to the load with shorter bus or cable runs.

2 **LOWER COST OF LOW VOLTAGE METAL ENCLOSED SWITCHGEAR**

Reduced transformer sizes at load centers require lower interrupting capacity circuit breakers, with resulting savings in switchgear costs.

3 **SMALLER WORK AREA AFFECTED BY POWER INTERRUPTION**

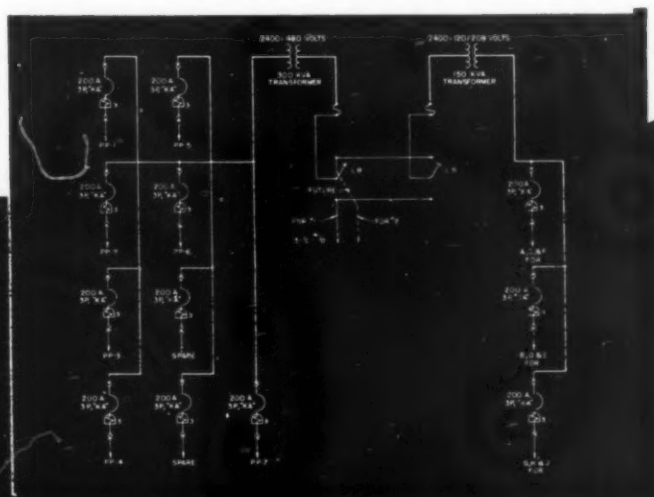
With individual I-T-E Unit Substations spotted at load centers, substations may be moved as load centers shift. Manufacturing processes in other sections of your plant are not affected — production is sectionalized.

4 **TIME SAVED AT INSTALLATION**

Piecemeal deliveries involve storing, assembling, testing. I-T-E substations are shipped to you as complete packages: factory engineered, assembled, tested before delivery. Time means money — save it!

5 **TIME AND MONEY SAVED IN YOUR ENGINEERING AND PURCHASING DEPARTMENTS**

Reduce your engineering specifications to a simple, one-line diagram—all you need to secure a quotation, complete with physical arrangement drawings and specifications covering all components of the substation: primary switchgear, transformer, secondary switchgear.



new bulletins and catalogs

Be sure to order your free copy of these booklets—they're the latest information published by leading manufacturers. Use the postage-free order cards on Page 37. Just list the Key Letters of the bulletins you want in the spaces provided on cards

BOILERS, AUXILIARIES, ACCESSORIES

Steam Condensers (A). Self cleaning reverse-flow condenser is fully described in 8-page bulletin. The self-cleaning feature, resulting from a reverse flow of water through the tubes, is thoroughly discussed as are the push-button controls. Cutaway views and flow diagrams show the various arrangements. C. H. Wheeler Mfg. Co.

Stokers (B). Pictures of recent installations, a drawing of the boiler setting and a cutaway view of the fuel bed illustrate this 16-page bulletin. Design and operating data are included. Stowe Stoker Div. The Johnston & Jennings Co.

Oil Burner (C). Belt driven, horizontal, rotary type oil burner is fully explained in up-to-date 6-page bulletin. Features such as dual pump reservoir, "Voluvalve" fuel regulator and high-speed belt drive are discussed in detail. Available in 36 sizes and combinations to 150 gph. Preferred Utilities Mfg. Corp.

Special Shape Refractories (D). Information on special shape refractories is contained in two-color bulletin. Shapes are engineered to individual furnace conditions in weights up to 500 lb. The Ironton Fire Brick Co.

PRIME MOVERS: DIESELS, TURBINES, COMPRESSORS

Heavy Duty Compressor (E). Two lines of stationary air compressors, one designed for normal industrial pressures of 100-125 psi; the other rated at 200 continuous, and up to 250 psi on intermittent service, are described in illustrated 8-page bulletin. Shows various sizes and models and gives cross-sectional views, engineering data and specifications. Ingersoll-Rand Co.

Portable Compressor (F.) Folder gives specifications and special features of new self-contained, gasoline-powered, portable compressor with illustrations of many applications. Ingersoll-Rand Co.

WATER AND LIQUID TREATMENT

One Minute Tests (G). Procedures, reagents and equipment for new "one-minute tests" to determine water hardness are pictured and described in 4-page bulletin. Total water hardness, or that due to calcium or magnesium alone, may be determined by this method. Hall Laboratories, Inc.

Water Conditioning (H). Colorful 24-page bulletin, replete with photographs, charts, cross-sectional drawings, diagrams and tables, tells the complete story of industrial water treatment. Presents methods and equipment employed in mixing, introducing and controlling the treatment solution. Describes the engineering service available for recommending and planning installations. Dearborn Chemical Co.

Water Problems (I). Various industrial water problems — procurement, treatment, usage and disposal — and the facilities and services offered in solving them, are described in 12-page illustrated booklet, "Your Most Important Raw Material." Hall Laboratories, Inc.

Water Softeners (J). Bulletin describes and illustrates the various types of automatic and semi-automatic zeolite water softeners. Features new poppet type multiport valve, which is built in many sizes and for both sodium cycle and hydrogen cycle ion exchange work. Hungerford & Terry, Inc.

Treating Feedwater (K). Development, filtration, backwash water, direct contact vent condenser, complimentary recirculation, backwashing, proportionate sludge removal and application of this system are discussed in 6-page bulletin. Included is a two-page questionnaire to determine the applicability of the system to particular conditions. Worthington Pump & Machinery Corp.

Rapid Mix Unit (L). Technical supplement gives complete data on rapid-mix unit for blending a liquid and one or more chemicals or gases with water, sewage or industrial waste, without the use of a mixing tank. Illustrations and diagrams show typical applications and installations, exploded view of the unit, section of the mixing chamber and dimensions. American Well Works.

Alkalinity Control (M). "Applications of Hydrogen-Zeolite Softened Water" shows how to blend hydrogen and sodium regenerated zeolite effluent to produce any desired alkalinity. Gives the reasons why alkalinity control is highly desirable along with flow diagrams to show how it's done. General Filter Co.

Centrifuges (N). Application of centrifugal force for separation and clarification of liquids is discussed in 4-page folder. Both tubular bowl and disc type centrifuges, together with the horizontal bowl decanter type and crystal dehydrator are summarized and illustrated. Sharples Corp.

Filters (O). File size, 8-page bulletin, illustrated with 3-color cutaway views, describes equipment for removal of water, oil and pipe scale from compressed air systems. Plant engineers can determine from tables exactly how much entrained water is hampering the efficiency of air distribution systems. R. P. Adams Co., Inc.

Scale Control (P). Electric scale control system is fully described in everyday language. What it is, does, and how accomplished, are thoroughly discussed in 4-page bulletin. Aqua Electric Scale Control, Inc.

ELECTRICAL EQUIPMENT

Switchgear (Q). Weatherproofed outdoor metal-clad switchgear is given detailed treatment in 4-page bulletin. Listed are tables of ratings and dimensions, floor plan, diagrams of standard assemblies and circuit arrangements for circuit breaker units. Available in ratings of 1200 and 2,000 amp; 5,000 and 15,000 v, 50,000 to 500,000 kva interrupting capacity. Allis-Chalmers Mfg. Co.

Wound-Rotor Motors (R). Complete construction, assembly and application data are contained in 2-page illustrated bulletin. Available in NEMA frames 203-505 and larger, to 600 hp. Star-Kimble Electric Co.

Power Fuses (S). Chapters on place and purpose, performance, construction, operation and ordering make up 16-page bulletin on drop-out fuses for circuits of 33,000 to 132,000 v. Well illustrated with photographs, cross-sectional drawings and charts. S & C Electric Co.

Stand-By Power Plants (T). Gasoline powered stand-by power plants, ranging from 500 w to 25 kw, are described in illustrated 6-page bulletin. Specifications, standard equipment, accessories and controls are listed. Kato Engineering Co.

Fuse Handbook (U). "Fuseology" is the title of informative 12-page handbook that gives the answers to electrical protection problems. Fuse blowing,

(Continued on page 24)

Keep heat and heating costs from "HITTING the CEILING"

THIS WINTER, why not see that you get *all* the heat you are paying for? Let Thermolier Unit Heaters bring both your heat—and your heating costs—down to a *reasonable* level.

HEATING COMFORT Thermolier Unit Heaters provide quick heating from a cold start. Desired temperatures are easily maintained within a close range. Heat is uniformly distributed in the working zone by forced air circulation. It is a very flexible system because different or changing heating requirements are easily satisfied by means of different models, a range of capacities, single — or two-speed motors and individual thermostatic controls.

LOW FIRST COST Thermolier Unit Heaters are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost. Additional savings are effected because the system requires a proportionately smaller amount of pipe, fittings and accessories.

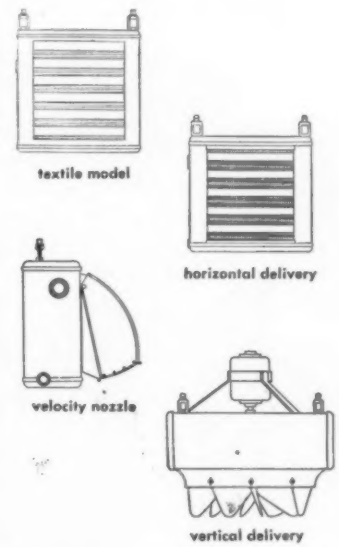
ECONOMY OF OPERATION Heat is forced down to the working level . . . not banked uselessly at the ceiling level. Heat is turned on and off merely by throwing a switch either manually or automatically by simple thermostatic controls. The rapid response means that heat is furnished only when and where it is wanted . . . no heat is wasted.

ADAPTABILITY TO EQUIPMENT AND FLOOR LAYOUT Thermolier Unit Heaters are widely used in industrial plants and warehouses, garages, stores and public buildings. The units and the simple piping are overhead where they do not interfere with arrangement of operating machinery or equipment and do not take up valuable floor or wall space. Units are easily relocated at any time to meet changes in layout.

THERMOLIER UNIT HEATERS HAVE IMPORTANT CONSTRUCTION ADVANTAGES The design of Thermolier Unit Heaters is the product of Grinnell Company's 100 years of heating experience. Heating experts like Thermolier's dependable operation, freedom from maintenance troubles and durability. Typical of its construction features is the patented internal cooling leg which permits the use of a plain thermostatic trap, the simplest, least expensive kind of a trap. Other features are built-in drainage, continuous rated capacity and provisions for expansion of U-tubes.

Get in touch with Grinnell or your local Thermolier distributor.

There is a type and capacity of Grinnell Thermolier for maximum heating results under every condition.



100th ANNIVERSARY — WHEREVER PIPING IS INVOLVED

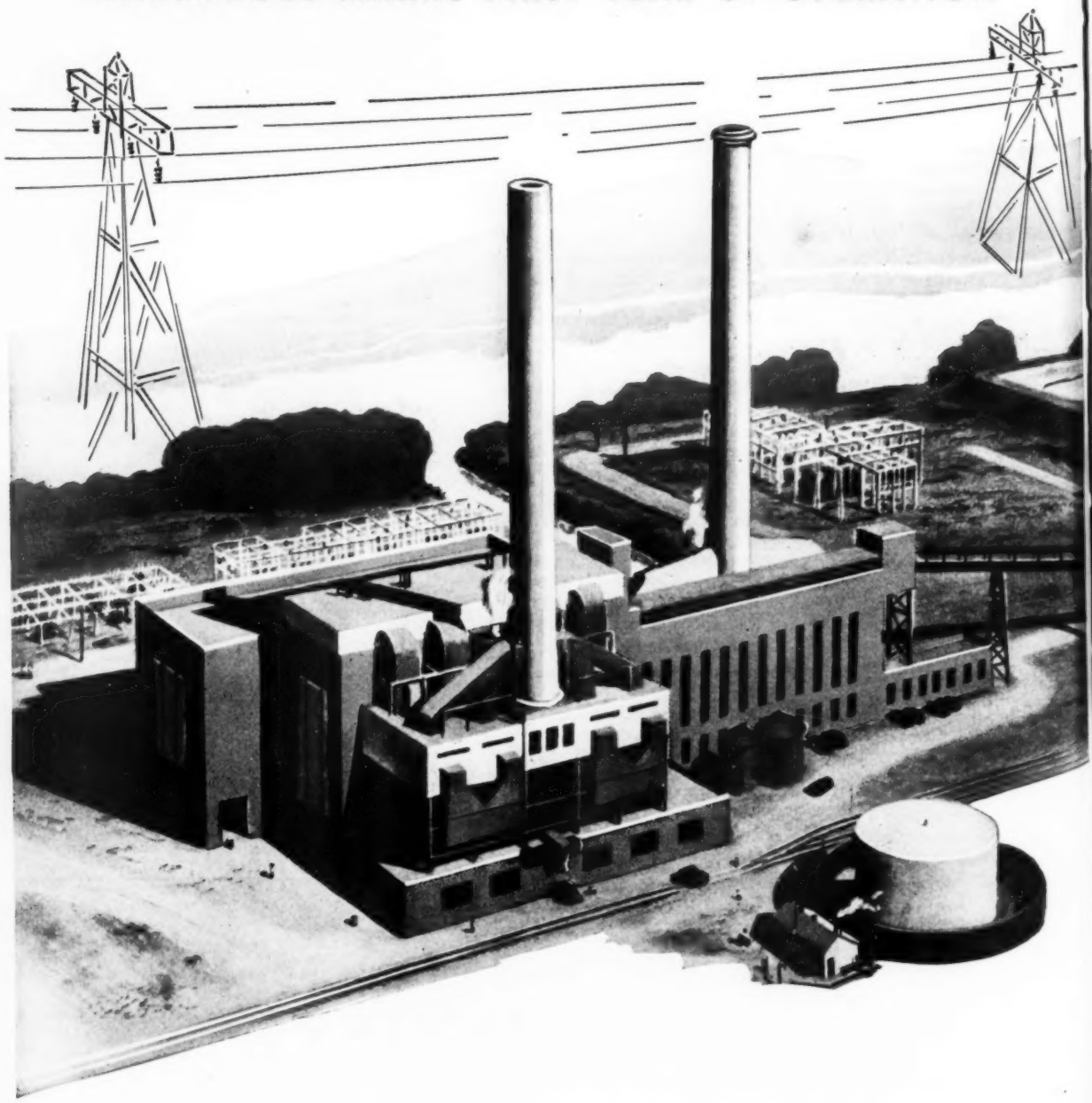
GRINNELL

THERMOLIER UNIT HEATERS

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

running lines into the future

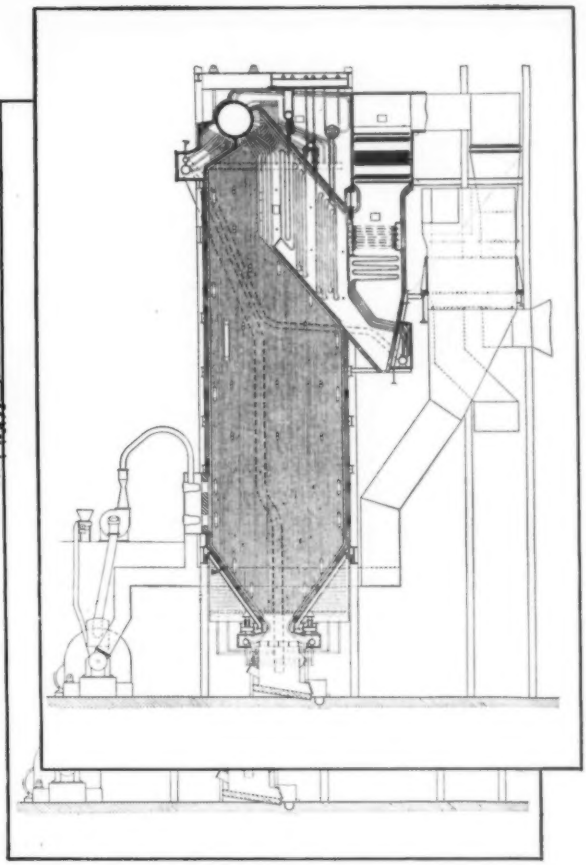
BARBADOES MARKS FIRST YEAR OF OPERATION



Two FOSTER WHEELER steam generators supply steam for the new turbines at BARBADOES STATION of PHILADELPHIA ELECTRIC COMPANY.

Steam Capacity per Unit	600,000 lb per hr
Superheat Control Range	330,000 to 600,000 lb per hr
Pressure Superheater Outlet	825 psi
Final Steam Temperature	900 F

Bituminous Coal Pulverized in FW Ball Mills (two per unit)



The growth in the supply of electric power keeps pace with the rising population and productivity of Philadelphia's highly industrialized Schuylkill Valley since two 66,000-kilowatt turbo-generator units were installed a year ago in the $24,000,000 expansion of the Philadelphia Electric's Barbadoes Station. This station, which has a total capacity of 180,000 kilowatts — enough for the needs of 500,000 homes — is part of the Company's electric system covering an area of 2,255 square miles and serving more than 900,000 customers.

A total of 1,200,000 lb of steam per hr is supplied to the new turbo-generators by two Foster Wheeler Steam Generators which have a performance record proving the advantages of such Foster Wheeler design features as slag-free furnace arrangement, low draft loss, and efficient heat recovery arrangement. Each unit is fired by two Foster Wheeler Ball Mill Pulverizers with facilities to permit full load operation with coal or gas.

The most advanced techniques permit the handling of 12,000 tons of coal, 30,000,000 pounds of steam and 250,000,000 gallons of water each day at Barbadoes. Only 11 men per shift are required to operate the two new units and steam generators.

FOSTER WHEELER

FOSTER WHEELER CORPORATION • 165 BROADWAY • NEW YORK 6, NEW YORK

(Continued from page 20)

fuse contact troubles, useless blowing, right sized fuses, are all given careful treatment with many detailed drawings and cutaway views. Conductor ratings and a volt loss table are given, as well as a short history and general construction of fuses. Bussmann Mfg. Co.

Generating Plants (V). Engine-driven electric generating equipment, in addition to electric plant accessories, is briefly described in 12-page listing of the various products fabricated by: D. W. Onan & Sons, Inc.

Insulation (W). New developments in wire and cable insulation are presented in 16-page house organ. Physical, electrical and weathering properties of the polyethylene covering are fully reviewed. Bakelite Div. Union Carbide & Carbon Corp.

Circuit Breaker Systems (X). Single- and double-pole circuit breaker systems up to 60 amp capacity are thoroughly discussed in 26-page illustrated booklet. Gives simple installation details and shows how nine enclosures can replace a multitude of safety switches, fuses, circuit breakers and panelboards. Federal Electric Products Co.

Electrical Equipment (Y). Condulets, plugs and receptacles, industrial lighting fixtures, controls, panelboards and signalling devices are featured in 168-page catalog. "Abridged Listing" includes only most active items and is designed for quick reference. Section is devoted to special metals, finishes, cord and cable sizes, general wiring and motor circuits. Crouse-Hinds Co.

Transformers (Z). Rural service distribution transformers in three basic types—with double gap and internal protective link, with arrestor-load limit combination, and with built-in secondary breaker—are described and illustrated in 6-pages. Allis-Chalmers Mfg. Co.

Power Factor Correction (2A). Examples illustrating basic considerations in the improvement of system power factor are contained in 4-page leaflet. It points out that the effects of a low power factor can be corrected, and graphically illustrates why and how synchronous motors and condensers improve the power factor. Allis-Chalmers Mfg. Co.

Nickel-Clad Copper Wire (2B). Technical data sheets with charts outline comparative mechanical and electrical properties and relationships between new nickel-clad copper and competitive metals. Also a complete description of what it is and what it will do. Alloy Metal Wire Co., Inc.

Dry Type Transformers (2C). Bulletin describes and illustrates complete line of dry type transformers. Includes open coil and completely enclosed types, unit substations and core and coil units. Sizes range from 0.1 to 2000 kva. R. E. Uptegraff Mfg. Co., Inc.

Storage Batteries (2D). Six new data sheets which help specification engineers select correct batteries have been announced. Each sheet includes a cutaway illustration and a series of capacity curves along with construction information. Also lists amp hr capacity and kw hr capacity at both the 6 and 8 hr rates of discharge. Gould Storage Battery Corp.

INSTRUMENTS, CONTROLS, RECORDERS

Mercury Switches (2E). If you need an automatic switch, which will not be affected by dust, dirt or corrosion, send for this catalog of mercury devices. They are designed for various applications requiring the control of pressure, temperature, liquid level and mechanical operations. The Mercoid Corp.

Liquid Level Indicators (2F). Complete details on construction, operation, installation suggestions, and dimensions are contained in 20-page revised bulletin which describes liquid level indicators and auxiliary attachments for remote indication of liquid level in boilers, feedwater heaters, storage tanks, etc. Yarnall-Waring Co.

Counters (2G). Scientific and industrial counters and recorders are covered in 4-page bulletin complete with photographs and drawings. Offers engineering service for adapting these machines, or for designing and developing special counters and recorders for unusual applications. Latest price list accompanies bulletin. Streeter-Amet Co.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Electronic Elevator Controls (2H). Color drawings highlight this highly informative 12-page bulletin on automatic supervision of elevator traffic flow. Thoroughly explains the six basic traffic programs that handle traffic loads automatically. Otis Elevator Co.

Thermometers (2J). Descriptive folder contains specifications for stationary and portable recording thermometers. Dial indicating instruments with solid liquid filled, and vapor tension actuated movements are listed together with several types of indicating thermometers. The Electric Auto-Lite Co., Instrument and Gauge Div.

Mechanical Differentials (2K). Accurate and convenient means of combining algebraically two mechanical quantities measured by angular displacement is described in 4-page illustrated folder. Arma Corp.

Draft Gages (2L). Information on diaphragm type straight-line draft gages is given in well illustrated 4-page bulletin. The free floating diaphragm is fully discussed as are other features such as, the translucent scale and the non-parallax pointer for easy reading. Ellison Draft Gage Co., Inc.

Recording Gages (2M). Measuring elements, operating principles, and accessories for water pressure, vacuum, low range draft and pressure, and absolute pressure gages are fully described in 32-page bulletin. Liberally illustrated with actual chart reproductions and application sketches in addition to photographs. The Bristol Co.

Fluid Controller (2N). New batch integrator that establishes a predetermined quantity of fluid by setting a photoelectric counter is presented in 2-page bulletin illustrated with schematic diagrams. Construction features are listed as are typical applications and adaptations. Republic Flow Meters Co.

Electric Meter Engineering (2P). Illustrated 16-page booklet discusses in detail the engineering services available for meters that measure and control electric energy. Commonwealth Services, Inc.

Flow Regulator (2Q). Cutaway illustration in color explaining the operation of the direct acting flow regulator is the principal feature of 4-page bulletin. Applicable for controlling flow of water, acids or oils at high or low temperature and high or low pressure. Specifications are given for 0.1 to 100 gpm sizes. W. A. Kates Co.

MATERIAL HANDLING

Conveying Machinery (2R). "What We Make", revised 48-page listing, contains photographs, drawings and brief descriptions of the many products fabricated. Included are chains, transmission machinery, conveying and crushing machinery, foundry equipment, equipment for water, sewage and industrial waste treatment, coal mining machinery and locomotives. The Jeffrey Mfg. Co.

Metal Turnings Crusher (2S). Advantages of crushing metal turnings are cited in 12-page bulletin illustrated with cutaway views and typical application photographs. Specifications and sizes in addition to a dimensional drawing are included. The Jeffrey Mfg. Co.

Vibrating Feeder (2T). Folder illustrates and describes vibrating feeders that employ mechanical means of operation. Vibrating conveyers are similarly treated in another 4-page bulletin. Simple design features both machines, greatly reducing maintenance. Robins Conveyors Div. Hewitt-Robins, Inc.

Slings (2U). Various types of wire rope slings, together with wire rope fittings, that can handle almost any size and shape load, are given comprehensive treatment in 72-page book. Application photographs and diagrams along with safe load tables are included. John A. Roebling's Sons Co.

Conveyers (2V). Sealed pin chains with synthetic rubber flights feature these conveyers, designed primarily for handling free-flowing abrasive dusts and sludges. Capacity table, layout drawings for handling various materi-

(Continued on page 135)

WOULD YOU PLAY A TOURNAMENT *with one club?*

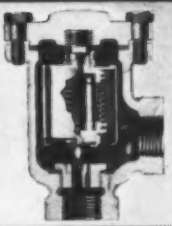
But on the golf course you can see the results. In steam hook-ups on the other hand, bad performance may go undetected for years, even though the traps apparently are working properly.

If you are in competition, it is certain that you cannot get the lowest fuel costs and highest production rates from steam heating and process equipment by "standardizing" on one type of steam trap for all purposes in your plant.

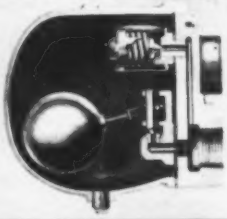
The four principal types of Sarco steam traps are illustrated at the right. They are available in a wide range of sizes and steam pressures and each has a specific function. The trick is to get the right trap on every steam job and every steam line in your plant. This can be done by calling in the Sarco Representative near you, or by asking for Sarco Catalog No. 1600 which gives recommendations for trapping all kinds of equipment, both indoors and out.

STEAM TRAPS ARE LIKE THAT...

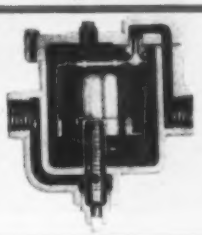
Thermostatic Trap



Float-Thermostatic Trap



Bucket Trap



Liquid Expansion Trap

312

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

SARCO SAVES STEAM

IMPROVES PRODUCT QUALITY AND OUTPUT

readers' guide to advertised products

Here you'll find, briefly reviewed, all the booklets and leaflets offered in the advertising columns of this issue of INDUSTRY AND POWER. For easy reference, this listing is divided into various classifications of products. To get your free copies of literature described here and in the corresponding advertisements, turn to Page 37 for a postage-free order card. There, list the Key Numbers of the paragraphs below and mail.

BOILER & FURNACE CONSTRUCTION UNITS

1—See page 149. Low Cost Steam: Data describes a boiler available in 6 sizes—6 to 36 hp. Economical to buy and operate. 6" scale with pipe diameter markings also sent upon request. Kewanee Boiler Corporation.

2—See page 145. Packaged Steam Boilers: Send coupon for full information on complete line of packaged steam boilers—fully automatic, 60 to 500 hp plus ample overload. Johnston Brothers, Inc.

3—See page 60. Vogt Products: Write today for further data on Vogt boilers, process equipment, chemical equipment, refrigeration equipment, valves and fittings. Henry Vogt Machine Co.

4—See pages 10, 11. Integral-Furnace Boiler: Write for Bulletin G-72. Gives complete data on cost saving features of the new B&W integral furnace boiler, Type FM. The Babcox & Wilcox Company.

5—See page 39. Packaged Steam Generators: New, fully illustrated Catalog 202 gives complete details for units available in 17 sizes. Write today. Superior Combustion Industries, Inc.

6—See pages 42, 43. Steam Generating Units: Select Riley equipment for efficient, trouble-free performance that cuts operating costs to minimum. Write today for further information. Riley Stoker Corporation.

7—See page 151. Waste-Heat Boilers: Write for complete facts on how these boilers will convert waste heat into profitable power in your plant. Wickes Boiler Co.

8—See page 140. "Economist" Boilers: Fully portable unit, bricked and insulated in steel case at factory requires no special foundation. Write for free catalog. Hapman-Dutton Co., The Dutton Boiler Division.

CLEANERS AND BLOWERS

9—See page 143. Combination Blower-Suction Cleaner: It's a snap to rid all of your equipment of damaging dirt, dust, and grit with this portable cleaning tool. Write for more data. Clements Mfg. Co.

10—See page 135. Axial Flow Blower: Send today for Publication No. 90—gives comprehensive data on Standardaire Blowers. The Standard Stoker Co., Inc.

COMPRESSORS

11—See page 137. Air Compressors: Ask today for free Folder STF-50; gives complete details on Schramm air compressors—compact, easy to move. Schramm, Inc.

DIESEL POWER

12—See page 34. Diesel Engines: Write for details on how Nordberg Diesels, in sizes from 10 to 8500 hp solve your power generation problems at major cost reductions. Nordberg Mfg. Co.

13—See page 55. Superior Diesels: Send today for new, fully illustrated booklet that shows you how Superior Diesels will cut power costs, or increase generating capacity in your plant. National Supply Company, Superior Engine Division.

14—See pages 52, 53. Diesel and Dual Fuel Engines: Write for full information on CP engines—available in sizes from 120 to 1750 horsepower. Chicago Pneumatic Tool Company.

DIESEL & FLY ASH COLLECTING EQUIPMENT

15—See page 122. Dust Control: Check the 8 ways Dracco Dust Control can save you money and write for full information on how Dracco results in increased plant efficiency. Write today. Dracco Corporation.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards on page 37. Mail today—postage-free!

16—See page 33. Fly Ash Collector: 'LR' Fly Ash Collector designed especially for small boilers — collects 99% of all 100-mesh cinder discharge. Fits small plant's boiler room. No cleaning, no water. Write for complete facts. Buell Engineering Company.

17—See page 29. Dust & Fume Control Systems: Kirk & Blum experts can design and install a complete dust or fume control system for your plant that will solve your problems. Write for full information. Kirk and Blum Mfg. Company.

ELECTRICAL EQUIPMENT

18—See page 131. Magnetic Starters: Write today for literature on Arrow-Hart "RA" magnetic starters. High arc resistance, ease of wire and servicing, balanced mechanism cuts space in half. The Arrow-Hart & Hegeman Electric Company.

19—See pages 18, 19. I-T-E Switchgear: For full information on how I-T-E unit substations can save you money five ways, read the advertisement on pages 18 and 19 and write for complete details. I-T-E Circuit Breaker Co.

FLOOR REPAIRS

20—See page 143. Floor Patch: Tough, plastic material restores broken concrete to solid smoothness. Write for details of free trial offer and hand book. Flexrock Company.

FUELS AND FIRING EQUIPMENT

21—See page 109. Automatic Coal Stoker: Exclusive with Combustioneer: "Pulsating" Transmission, Automatic Respirator and "Breathing" Fire Bed. Write for further information on commercial models and free heating analysis. Combustioneer, The Steel Products Engineering Co.

22—See page 116. Fuel Oil Additive: Houghto-Solv dissolves all the sludge in your entire system—cleans tanks, lines, strainers, pumps, nozzles, etc. Write for free descriptive folder today. E. F. Houghton & Co.

(Continued on page 30)

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

— BLUE RIBBON BLOWERS —

THE BLOWERS THAT PUT MORE MINUTES IN EVERY HOUR

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 190 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

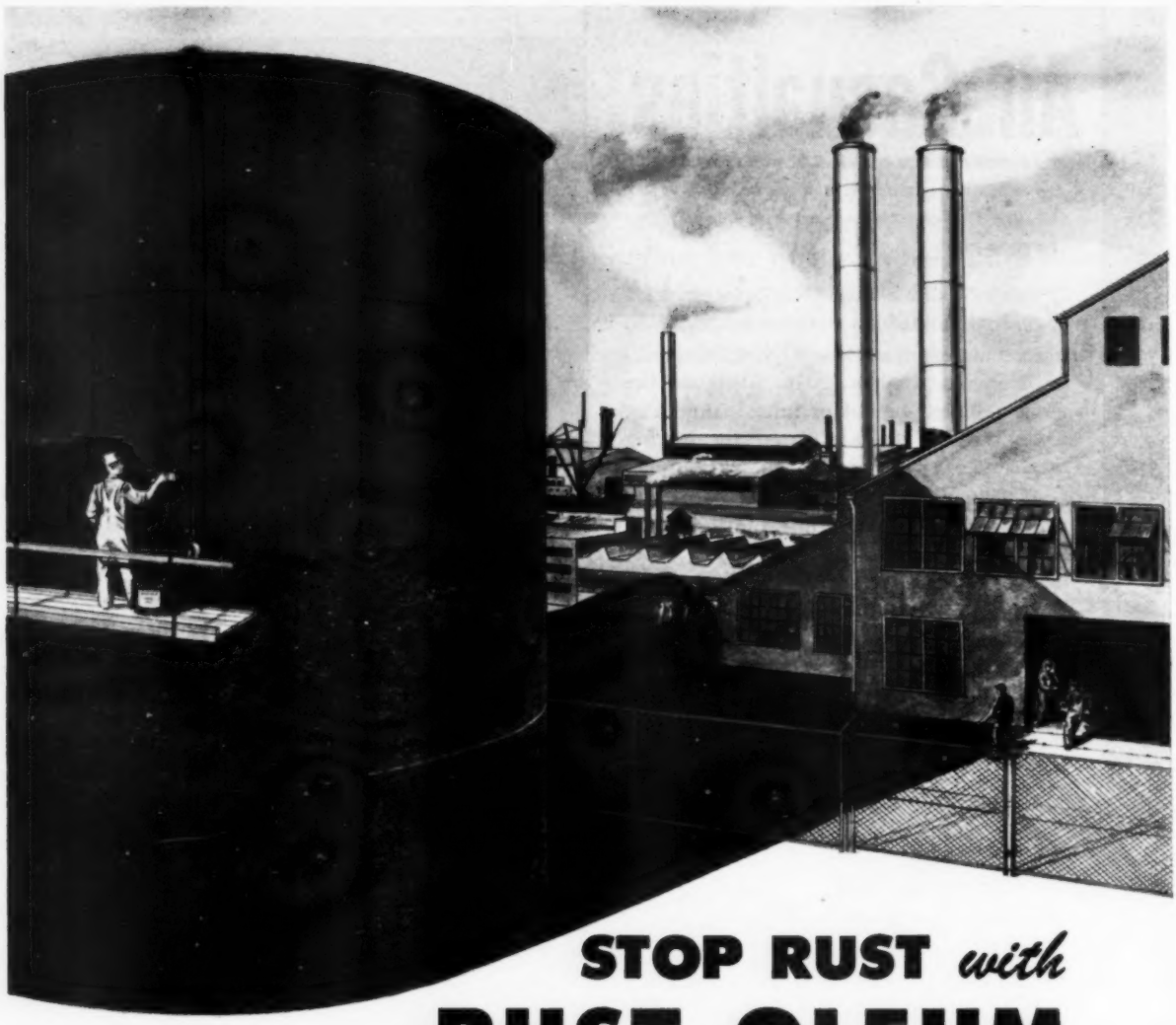
NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)



STOP RUST *with* RUST-OLEUM

If you have a rust problem, and would like a free survey and recommendations, send your name and address on your business stationery. A qualified factory representative will arrange this free service, which includes a trial size of Rust-Oleum for specific test purposes. There is no obligation on your part. Write today.

Every day rust eats away at your metal tanks, buildings, fences, stacks . . . everything metal inside and outside your plant. Yet, rust and costly rust depreciation can be *stopped instantly . . . economically* . . . with RUST-OLEUM.

Industry of all kinds . . . railroads, steamship lines, iron and steel companies, refineries, in fume-choked industrial and coastal areas have proved Rust-Oleum for more than 25 years. They know that Rust-Oleum stops and prevents rust!*

Rust-Oleum can be applied without extensive preparation . . . even over surfaces that are already rusted. Rust-Oleum spreads evenly . . . free of brush marks. Its tough, pliable finish protects against every kind of weather, against fumes and heat . . . even against salt air and salt spray.

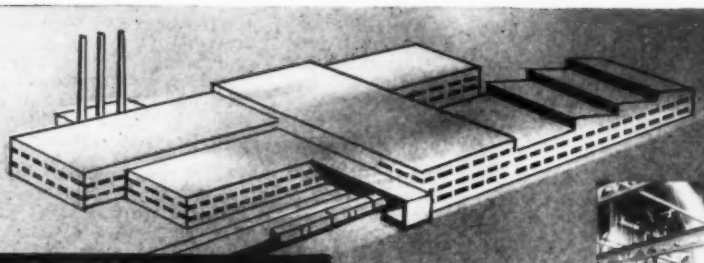
Beauty and durability are combined in Rust-Oleum for it is available in a large selection of colors . . . including aluminum and white.

Don't wait another day! Let Rust-Oleum give you safe, sure, economical protection against rust. Use it to protect all your metal surfaces. Specify it to your painting contractor or architect. Industrial distributors in all principal cities of the United States and Canada stock Rust-Oleum to supply your every need. See Sweets for complete catalog and nearest source of supply, or write us direct.

** Names on request.*

RUST-OLEUM CORPORATION

2472 Oakton Street, Evanston, Illinois



DESIGN
FABRICATION
INSTALLATION

"for all three call K&B!"

For 42 years, Kirk & Blum has specialized in the DESIGN, FABRICATION and INSTALLATION of efficient, dependable systems for the removal of dust and fumes.

DESIGN: Kirk & Blum engineering specialists survey your plant and then design your system, selecting equipment most suitable for your problem.

CONSTRUCTION: Kirk & Blum fabricates the complete system (equipment excepted), "tailor made" for your installation.

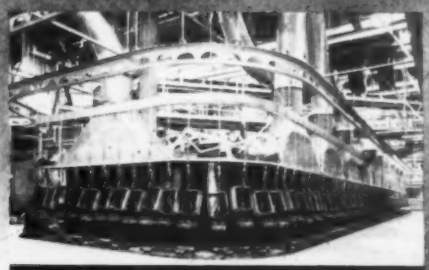
INSTALLATION: The Kirk & Blum contract includes responsibility for the entire system, installed by mechanics with years of specialized experience in the installation of such systems. As a result, you have one undivided responsibility —one complete contract for an installed system, ready to operate.

FOR CLEAN AIR . . . THE INVISIBLE TOOL

KIRK AND BLUM

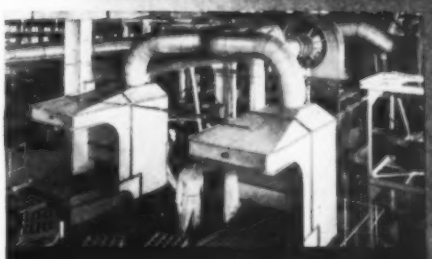
DUST AND FUME CONTROL SYSTEMS

THE KIRK & BLUM MFG. COMPANY
2874 SPRING GROVE AVE.,
CINCINNATI 25, OHIO



View in new Southern Foundry, shows pouring station with K & B system which removes smoke and fumes as they are formed.

"Shakeouts" in the foundry of a noted implement firm equipped with K & B Dust Control System.



Another K & B system for production line shakeouts. Note that Dust Control equipment does not interfere with production.

K & B Plenum Chamber Hood for mold conveyor operation. Note bolted section construction for ease of maintenance.

readers' guide to advertised products

(Continued from page 26)

23—See page 15. Detroit Stokers: Write today for full information on Detroit Stoker's complete line—Lokostokers, Unistokers, Double Retort, Rotostokers, and Rotograte stokers. Detroit Stoker Company.

HEATING, VENTILATING AND AIR CONDITIONING

24—See page 27. Blowers: Check and mail coupon on page 27 for full information on how Coppus blowers or exhausters supply fresh air to men working, and step up production. Coppus Engineering Corp.

25—See page 124. Heating Specialists: Let Petro-Chem Development Company engineers help you solve your heating problems of indirect versus direct heating and economies of both. Write for information. Petro-Chem Development Co., Inc.

26—See page 70. Unit Heaters: Write today for details of this complete range of well graduated sizes, in horizontal and blowdown types, of these unit heaters built for maximum output at minimum cost. Fedders-Quigan Corporation.

HEAT EXCHANGERS

27—See page 136. Cooling Towers: Pritchard towers guaranteed to meet your peak as well as normal load requirements—effect maximum saving of water. Write for free bulletins today. J. F. Pritchard & Co.

28—See page 17. Fin Fan Heat Exchangers: Write today to reserve your new 8-page folder on Fluor GR Fin Fan heat exchangers—for gas cooling, vapor condensing, liquid cooling. Fluor Corporation.

INSTRUMENTS

29—See page 142. Automatic Liquid Measuring Gages: Write for complete details on liquid level gages for measuring liquids of all kinds. Dial readings in feet, inches, gallons, pounds or any desired units. The Liquidometer Corp.

30—See page 139. All-Metal Thermometers: Write for complete data on these easy-to-read, ruggedly constructed thermometers for most industrial applications. Wide variety of types. Weston Electrical Instrument Corporation.

31—See page 146. Ernstilt Adjustable Inclined Column: Write for Bulletin T-1. Contains specifications of this adjustable inclined column designed for package type boilers up to 300 lbs. W.S.P. Ernst Water Column & Gage Co.

32—See page 132. Analyzer: Write today for Bulletin 900. Gives full details on this CO_2 Analyzer—thermal conductivity method combines the simplicity of equipment with extreme accuracy. Charles Engelhard, Inc.

33—See page 4. Combustion Control: Write for full details on Hays electrically automatic combustion control system. Save fuel this modern, efficient way. The Hays Corporation.

34—See pages 62, 63. Gages: Write for information on the new Yarway Type "M" illuminator that lets you see instantly accurate boiler water level. Lets you spot water level over entire traverse. Yarnall-Waring Company.

35—See page 141. CO_2 Indicator: You can check for carbon in flue gas easy and quickly with the Fyrite. Write for free Bulletin 740 for full description of this accurate, dependable index of combustion efficiency. Bacharach Industrial Instrument Co.

INSULATION

36—See page 69. Kaylo Insulating Material: Available in block or pipe covering form, this material is remarkably efficient throughout a wide 200°-1200° F. temperature range. Send for descriptive literature. Kaylo Division, Owens-Illinois Glass Co.

37—See page 105. Industrial Insulation: Send for new booklet on B-H Block insulation made with black rockwool, flexible and easy to cut, fits tightly over irregular surfaces. Write today. Baldwin-Hill Co.

LUBRICANTS AND FILTERS: PURIFIERS AND LUBRICATORS

38—See pages 46, 47. Lubricants: Ask for more information about Rubilene—top quality oil providing uniform, trouble-free lubrication over long periods of use. Sinclair Refining Co.

39—See page 57. 11 Ways to Cut Production Costs: Write for your copy of this free, new booklet which is your without obligation. You will find handy coupon on page 57. Alemite Corporation.

40—See page 133. Non-Fluid Oil: Send for instructive bulletin and free testing sample on Non-Fluid Oil for positive bearing protection. New York & New Jersey Lubricant Company.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards on page 37. Mail today—postage-free!

41—See page 145. Centralized Lubrication: Ask for free Catalog No. 25 and Case Studies showing how to save oiling labor, bearing expense, production time and lubricant. The Farval Corporation.

42—See pages 35, 36. Industrial Oil: You can depend on Stanoil for clean, maximum performance in hydraulic units, speed reducers and circulating systems—expert, personal service by Standard Oil lubrication specialists available, too. Write for full information. Standard Oil Company (Indiana).

43—See page 103. Lubricants: Sunvis 900 Oils are good for the life of your machine. Designed for toughest lubrication jobs throughout industry. Write today for free booklet. Sun Oil Company.

44—See page 114. Lubriplate: Write today for authentic information on how these lubricants effect maximum savings even in unusually severe lubrication problems. Fiske Brothers Refining Company, Lubriplate Division.

MAINTENANCE

45—See page 28. Rust Preventive: Rust-Oleum seals metal so that no rust-causing oxygen can reach it. Available in a full range of colors. Write for complete catalog. Rust-Oleum Corporation.

46—See page 146. Free Repair Handbook: Filled with time-saving, money-saving uses for Smooth-On in plants and shops. Clear, practical directions. 170 illustrations. Send today for your copy. Smooth-On Mfg. Co.

47—See page 128. Maintenance Equipment: Write for free 40-page handbook on Commutator and Slip Ring Maintenance and full information on resurfacers, precision grinders, undercutters, flexible abrasive. Send coupon today. Ideal Industries.

MATERIAL HANDLING

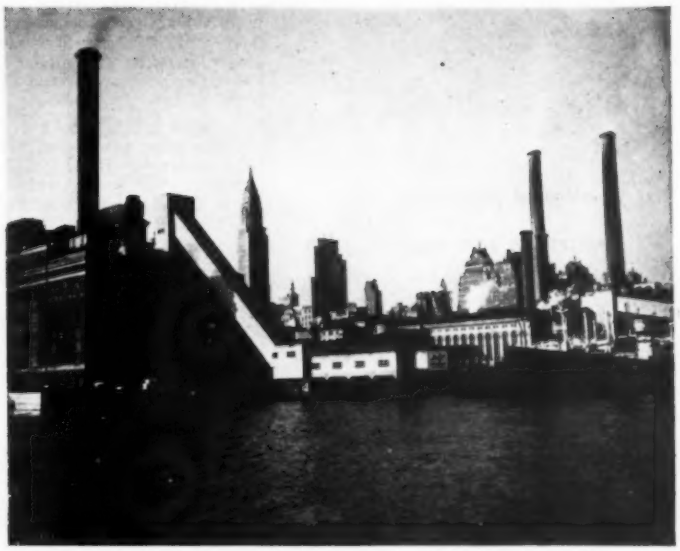
48—See page 143. Freight Elevators: You're sure of superior construction and plus-performance with Reading Freight Elevators—hydraulic, electric or self-supporting drum machines. Write for full data. The Reading Elevator Co., Inc.

49—See page 130. Ash Handling: Write today for detailed illustrations on how "Vac-Veyor" system will help you solve your materials handling problem. Beaumont Birch Company.

50—See page 125. Fireless Locomotives: Send coupon or write today for data on these highly economical locomotives. They save up to 50% of your switching costs. Require minimum maintenance. H. K. Porter Company, Inc.

(Continued on page 32)

3 GOOD WAYS TO Stop Wasting Water



1 Make *raw* water fit for industrial use by *straining* it.

If you're in a scarce-water community, save water and cut your water bill—use a Cuno FLO-KLEAN strainer to remove trash from river or lake water. Its permanent wire-wound cartridge positively removes all solids larger than specified*, with negligible drop in pressure.

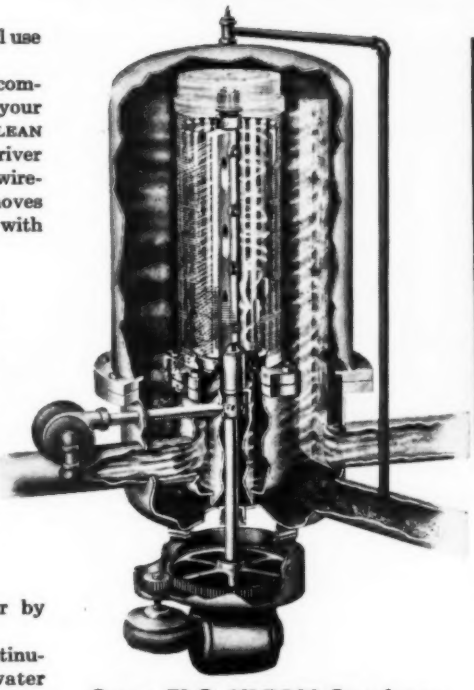
2 Reclaim and recirculate *used* water by *straining* it.

If you use water for process work, lower your water and water-heating costs—clean out contaminating solids with a Cuno FLO-KLEAN, and recirculate. Being continuously self-cleaning, it handles full flow—no expensive duplex installation needed.

3 Save valuable *backwash* water by using a FLO-KLEAN strainer.

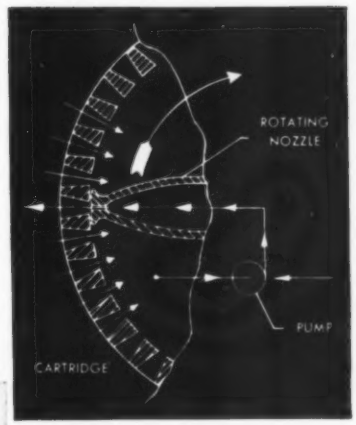
Only Cuno FLO-KLEAN is continuously self-cleaning without water waste. Used backwash is returned to the system. And—with automatic cartridge and automatic top and/or bottom blow-down—it can be installed in a remote place and virtually forgotten.

Available spacings from .0025 to .020 in.



Cuno FLO-KLEAN Strainer

Permanent, abrasive and corrosion resistant.



Cuno's unique backwash system wastes no water.

FLO-KLEAN PAID FOR IN ONLY 6 MONTHS!

A bottling plant in a scarce-water area saved water and paid for its FLO-KLEAN in 6 months out of savings from making wash water reusable.

Find Out How to Save Money *cleaning any fluids containing abrasives*

No Fluid Is Better Than Its Filtration

CUNO

Complete Line Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (MICRO-KLEAN) DISC-TYPE (AUTO-KLEAN) WIRE-WOUND (FLO-KLEAN)

CUNO ENGINEERING CORPORATION
1410 South Vine St., Meriden, Conn.

Please send information—without obligation—on Cuno FLO-KLEAN for application noted:

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.....
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Name.....Title.....
Company.....
Address.....
City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

readers guide to advertised products

(Continued from page 30)

PACKINGS AND GASKETS

51—See page 121. Navalon Packings: Made of "ramie", these packings give service against fresh or salt water, brine, cold oil, and for use on pumps, elevators, etc. Write for folder PK-32 A. Johns-Manville.

52—See page 45. Piston Packing: Pumcups cut downtime and material and maintenance costs to minimum, hold volumetric efficiency constant. Write for free bulletins No. 4401 and 4402. Darling Valve & Mfg. Co.

PIPE AND FITTINGS

53—See page 13. Copper Tubes for Industrial Applications: Booklet C-24 describes copper tubes and fittings for plumbing, heating, mechanical and process uses. The American Brass Co.

54—See page 133. Pipe Fabricating Specialists: Meet your most exacting specification with absolute satisfaction on all pipe fabricating for oil, chemical, concrete, asphalt, and other industrial requirements. Albert Pipe Supply Co., Inc.

55—See page 145. WECO "Junior" Unions: Made for 3,000 lb, non-shock cold working pressure, in sizes ⅛" thru 2". Illustrated brochure available for complete information. Write for your copy today. Well Equipment Mfg. Corp.

56—See page 41. Flexible Metal Tubing and Metal Hose: Write for literature describing the many uses and types for handling steam, water, oil, solutions, semi-solids, or gases. American Metal Hose Branch, The American Brass Company.

57—See page 50. Expansion Joints: Copper and stainless steel expansion joints to solve problems of expansion, vibration, and misalignment in pipe lines. Chicago Metal Hose Corporation.

58—See page 129. Pipe Unions: Easy to tighten, easy to uncouple, practically indestructible. True ball joint makes the difference. Write for full information today. E. M. Dart Mfg. Co.

59—See page 40. Boiler Tubes: Let B & W Tube representatives uncover unexpected tube economies for you and solve your toughest tube problems. Write for nearest B & W representative. The Babcock & Wilcox Tube Company.

PLANT EQUIPMENT

60—See page 140. Steel Grating: Bulletin NA 1140 fully describes the Dravo line of Tri-lok grating, safety treads, open steel flooring, concrete armoring and other products. Send for your free copy. Dravo Corporation.

61—See page 144. Steel Work Bench: Send today for Bulletin 702—complete details for this all-steel constructed, finest quality cabinet bench. Standard Pressed Steel Co.

POWER TRANSMISSION

62—See page 3. Conveyor Belts: Call your nearest Goodyear Technical Man or Write today for help in selecting the belt that will handle more coal for longer periods at less cost. Goodyear Tire & Rubber Co.

63—See page 149. Motor Couplings: Ask for Catalog 57 which gives full details, ratings, and service factors for gear-type, all-steel couplings. John Waldron Corporation.

64—See page 66. Chain Drives: Rex Chabelco line of chains and sprockets are specifically designed for drive service on equipment where steady, uninterrupted service is a "must". For all the facts on their lower over-all cost, write Chain Belt Company.

65—See page 107. Spherical Roller Bearings: SKF bearings are self-aligning, long-lived, require infrequent lubrication and inspection. Write for complete details. SKF Industries, Inc.

66—See page 59. Flexible Metal Packing: Highly resilient, flexible R/M No. 920 packing is made of asbestos yarns covered with metal foil. For full information send coupon or write to Raybestos-Manhattan, Inc.

67—See page 144. Worm Gear Speed Reducers: Catalogs 200 (for standard drives) and 300 for Speedaire (fan-cooled) give you full information on all types and sizes of Worm Gear Speed Reducers. Write today. The Cleveland Worm & Gear Co.

68—See page 115. Roller Bearings: Hyatt Hy-Loads provide high load capacity, long life in shaft location. Catalog 547 gives full information on all ten types of Hyatt Hy-Loads. Write for your copy today. Hyatt Bearings Division, General Motors Corporation.

69—See page 136. Magnolia Metal: Need a bar? box? or ton of babbit metals? Use Magnolia distributors and avoid idle stocks. Write for complete information. Magnolia Metal Company.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards on page 37. Mail today—postage-free!

PUMPS

70—See page 64. Warren Pumps: Be sure to check with Warren when you plan modernization or expansion of your plant. Send for full information of complete line of pumps. Warren Steam Pump Company, Inc.

71—See page 146. Condensation Return Units: Bulletin 113-ST gives complete details on APCO packaged condensation return units for small low pressure jobs. 10 to 40 lbs. with 8, 15, 30 gallon receivers. Write today. Aurora Pump Company.

72—See page 108. Centrifugal Pumps: Weiman pumps work at maximum efficiency on every job efficiently, dependably, economically. Write for full information. The Weinman Pump Mfg. Co.

73—See page 71. Chemical Feed Systems: Write for Bulletin 4811 and Technical Paper No. 51 "What the Power Engineer Needs to Know about Chemical Feed Systems". Milton Roy Company.

REFRACTORIES

74—See page 142. Refractory Cement: Bulletin describes Super #3000 Refractory that protects inside insulation of metal ducts, flues and breechings with maximum efficiency. Write today. Refractory & Insulation Corp.

REGULATORS AND CONTROLS

75—See page 106. Mercury Switches: Write for further information on these switches that are not affected by dust, dirt or corrosion. Let Mercoid solve your control problems. Complete catalog sent upon request. The Mercoid Corporation.

76—See page 118. Temperature and Humidity Control: Pneumatic system of temperature control can cut fuel consumption 15 to 25%, increase output of workers, improve quality of products. Write for full details. The Powers Regulator Co.

77—See page 68. Pressure and Temperature Regulators: Write for Bulletin 350. Spence gives full data on Spence Regulators. They operate at low unit stress for long life, cut down maintenance cost. Spence Engineering Company, Inc.

78—See page 145. Temperature Regulators: Write for Stacon Bulletin 50-1000 for full details on extra sensitive, accurate, economical temperature regulators. Farris Stacon Corporation.

79—See page 7. Reducing and Desuperheating Control: Swartwout supplies combination of equipment best suited for exacting control of output of modern high pressure boilers. Write for full information. Swartwout Company.

(Continued on page 37)

"Why am I an Orphan?"

...said the small-boiler operator

He was in a pretty tough spot. *Sure,* he wanted to collect his fly ash. But how could he afford a custom-engineered fly ash collector for a boiler under 2000 BHP? He *hated* to think of installing *anything* short of a real fly ash collector!

Could we help? Simple... just tell him about the new Buell 'LR' (Low Resistance) Fly Ash Collector!

SPECIALLY DESIGNED FOR SMALL BOILERS

The cost of the 'LR' Fly Ash Collector fits the smaller plant's budget nicely. Yet the 'LR' is guaranteed to collect 99% of all 100-mesh cinder discharge. And the draft loss is so low you can even use the 'LR' on a *natural draft* boiler!

Practical? The 'LR' is chunky, compact... made to fit a small plant's boiler room. And there's no cleaning, no water, and no maintenance except emptying the hopper!

If you run a coal-fired boiler between 100 and 2000 BHP, write for complete facts on Buell's new 'LR' Fly Ash Collector. Buell Engineering Company, Suite 5017, 70 Pine St., New York 5, N. Y.

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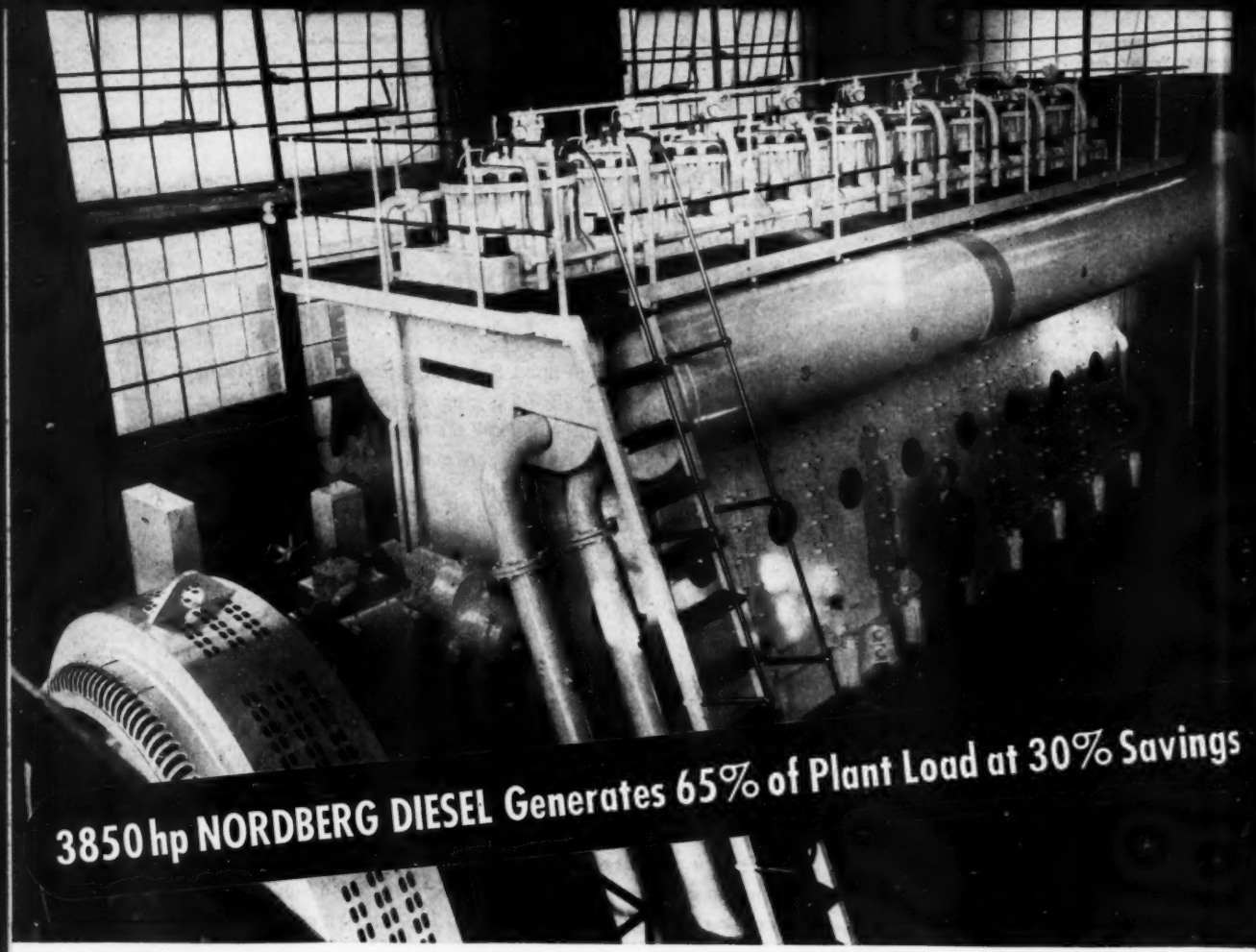
Engineered Efficiency in

Fly Ash Collection

'LR' for small boilers



3850 hp NORDBERG DIESEL Generates 65% of Plant Load at 30% Savings

With the installation of this nine-cylinder 3850 hp Nordberg Diesel in the Village of Freeport, N.Y. light and power plant, and with a total capacity of 17,310 hp installed, this makes one of the largest municipally owned diesel-electric plants in the United States.

Usually the first few months of engine operation are used for break-in and adjustments, but in this case the new engine went right to work and established a number of plant performance records. In little more than five months, the diesel was in operation 3,386 hours, and made the longest continuous run of any engine in the plant.

Just before the Nordberg Diesel began its full-time operation, the plant's average cost per kwh, including fuel, lube oil, labor, maintenance, supplies, insurance, depreciation, and miscellaneous expenses, was 11.4 mills. The corresponding cost for the Nordberg unit is just 8 mills, a reduction of about 30%, and a figure set by Chief Engineer Thomas Moore as a goal for the entire plant.

During summer months, Freeport's load varies from a low of about 2,000 kw in the early morning hours to a peak of about 5,500 kw. Running alone, the big Nordberg handles the valley load nicely; when load rises, it continues to carry a relatively high percentage, which makes for operating convenience and efficiency. Mr. Moore estimates that this one engine is generating 65% of the plant's kwh production.

Here, then, is another good example of the way in which Nordberg Diesels, in sizes from 10 to 8500 hp are being used to solve municipal and industrial power generation problems. Write for details, outlining your requirements.

NORDBERG MFG. CO., Milwaukee 7, Wisconsin

P550

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

Schooled to serve you...

YOU benefit when these men go to school!

These men are Standard Oil lubrication specialists, skilled and experienced in the use of modern lubricants. They are representative of the groups who come year after year from Standard Oil Company (Indiana) sales fields throughout the Midwest to learn about new machinery and the most up-to-date methods of lubricating them. In lecture rooms and in well-equipped laboratories, they are taught new ways to raise economy and efficiency of your operations.

The benefits held out to you by these lubrication specialists are multiplied by a service-distribution set-up that is unique in the oil industry. To serve your midwest operations, Standard Oil has located practically right in your own backyard a completely stocked warehouse and the office headquarters for a lubrication specialist. The nearness of this service-supply center *means faster deliveries to you* of necessary fuels and lubricants. It assures you of getting the product you need when you need it. It puts the services of the lubrication specialist at your immediate disposal.

These advantages are well worth investigating. Arrange, now, for the visit of a lubrication specialist. If your plant is located in any of the states below, simply phone your nearby Standard Oil service-supply center or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

3 IMPORTANT ADVANTAGES

Standard Oil's Lubrication Service is especially geared to serve your midwest operations.

1 SERVICE-SUPPLY POINTS are near your plant. You are assured of fast deliveries, prompt lubrication engineering service.

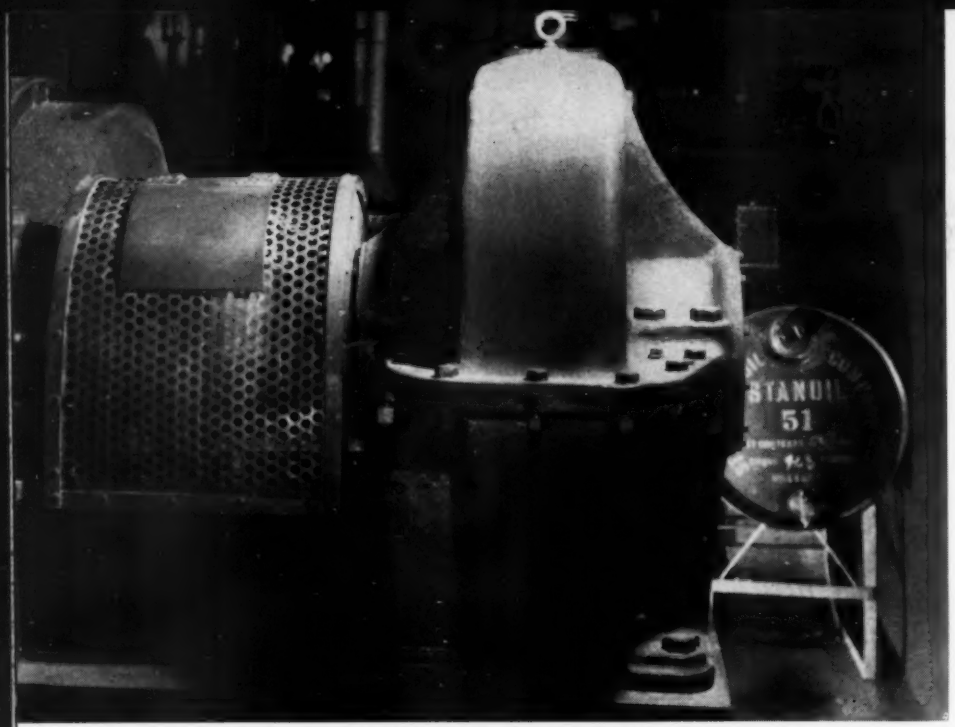
2 LUBRICATION SPECIALISTS have been specifically trained in Standard Oil Lubrication Engineering Schools to help you obtain the maximum benefits from lubricants and fuels.

3 RESEARCH AND TECHNICAL FACILITIES are geared to help solve your specific lubrication problems.

Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Montana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin, Wyoming

STANDARD OIL COMPANY (INDIANA) STANDARD

F550



Arrest the dirty work in reduction gears

THE dirty work starts in reduction gears when the lubricating oil begins to oxidize and break down under the attack of heat and air. Oxidation products, uniting with dust and other foreign matter, form deposits which interfere with proper lubrication and cause gear wear.

STANOIL
TRADE MARK
Industrial Oil

You can head off this dirty work—avoid costly cleaning jobs, oil changes, and gear wear—by using STANOIL Industrial Oil. The high stability of STANOIL prevents deterioration by heat. Its low-carbon-forming base oil keeps gears free from carbon. An inhibitor curbs acidity growth which would cause the formation of emulsions and sludge.

The many qualities of this one oil enable it to handle a wide variety of jobs in your plant. To assure you maximum benefits from STANOIL and other high-quality petroleum products, the Standard Oil Company has a well-trained and experienced lubrication specialist located practically at your doorstep. How you can profit by this unique product-service combination is explained at the right.

Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

What's YOUR problem?

• To help you solve particular lubrication problems or gain greater all-around economy, Standard Oil has set up an industrial service that's unrivalled in the Midwest. This service puts at your immediate disposal the help of a highly trained, experienced lubrication specialist and a reliable supply of petroleum products. All you need do is phone or address a card to the nearest Standard Oil Company (Indiana) office. In fact, why not start right now by arranging for the visit of the lubrication specialist assigned to your plant. With his help, find how many different oils in your plant can be replaced by STANOIL Industrial Oil on such applications as:

Hydraulic systems... cleaner operation, no foaming troubles.

Air compressors . . . no sticking or clogging of valves, less oil consumption in splash or circulating systems.

Speed reducers . . . less wear of gears and bearings during frequent cold starts or prolonged high-temperature operation.

Steam turbines... freedom from emulsions and sludge, fewer oil changes necessary.

Ring-oiled bearings . . . rings function immediately on starting, less bearing wear.

Circulating and bath systems ...one oil for a wide variety of jobs.

STANDARD **STANDARD OIL COMPANY (INDIANA**

readers' guide to advertised products

(Continued from page 32)

80—See page 144. Regulators and Thermometers: Bulletins 500 and 1000 give you full data on regulators and thermometers that will cut your processing cost to a new low. H. O. Trerice Co.

STEAM TURBINES AND ENGINES

81—See page 119. Terry Turbines: Send for Bulletin S-143 that gives full details on interesting facts and outstanding features of Terry Turbines—wide range line to fill your turbine needs. The Terry Steam Turbine Co.

TOOLS AND SMALL SPECIALTIES

82—See page 120. Tube Cleaners and Expanders: Write today for complete information on Airetool cleaners and expanders for every type of tubular construction. Airetool Manufacturing Co.

83—See page 140. Chain Tongs: For pipe, fittings, and flanges. Write for catalog for complete showing and description of "Reversible," "Standard" and "Ideal" types in all sizes. Armstrong Bros. Tool Co.

84—See page 126. Pipe Threader: Compact, portable power pipe threader operates with a ½" portable electric drill. Write for complete catalog of better pipe tools. Armstrong Bros. Tool Co.

85—See page 140. Belt Fasteners: Send for free circular on belt fastener No. 500. Makes strong, flexible joints and conveyor belts of any width—⅛" to ½" thickness. Armstrong-Bray & Co.

86—See page 134. Seat Scraper: Simple, hand-operated tool saves you expensive man-hours in cleaning inside cap seats. Write for bulletin and prices. Elliott Company—Roto Division.

TRAPS, STRAINERS AND SEPARATORS

87—See page 152. Steam Traps: No extra in price for extra quality. Write for facts that show why you'll want to specify Silvertop Steam Traps. V. D. Anderson Co.

88—See page 51. Impulse Steam Traps: To get equipment hot and into production faster, use Yarway impulse steam traps. Write for full information on how these traps keep equipment continuously at peak operating temperatures. Yarnall-Waring Company.

89—See page 117. Pipe Line Filters: Staynew Double Action Pipe Line Filter's guarantee, in one unit, plus performance—mechanical separation and filtration. Write for complete data. Dollinger Corporation.

90—See page 25. Steam Traps: Write for Sarco Catalog No. 1600 for recommendations on trapping all kinds of equipment, both indoors and out—standardized throughout your plant. Sarco Company, Inc.

VALVES

91—See page 142. Air Control Valves: Bulletin "A-P" gives full description of Valvair's 2-way, 3-way and 4-way air controlled valves featuring maximum dependability. Write today. Valvair Corp.

92—See page 132. Butterfly Valves: Write for Catalog describing Rockwell valves for air, gas, liquids and solids. Any desired metal. Pipe sizes to 72" and larger. W. S. Rockwell Company.

93—See page 106. Steam Jacketed Valves: Write for full information on Everlasting Valves that insure clog-free operation, keeps viscous materials flowing freely. Everlasting Valve Co.

94—See page 127. Valves: Outstanding design, sound engineering and rugged construction are built into every Fairbanks valve to meet all kinds of valve requirements in industry. Write for details. The Fairbanks Company.

95—See page 56. Check Valves: Chapman Tilting-Disc Check Valves practically eliminate pipe line stresses—head losses are reduced 65% to 80%. Write for Bulletin No. 30. The Chapman Valve Mfg. Co.

96—See page 110. Steel Valves: For complete steel valve data, write today Lunkenheimer steel valves have outstanding records of safety and long service due to metal quality and care-

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers or letters of the paragraphs describing the items you want in the spaces provided on cards.

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readers' guide to advertised products

(Continued from page 37)

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97—See page 54. Throttling Valves: Whether you need throttling valves or any other type, insist on Crane Quality —pays off in years of service. Write for information. Crane Co.

98—See page 143. Multiport Valves: New Bulletin V-11 gives full data on H & T Poppet Type Multiport Valves for manual, semi-automatic or fully automatic zeolite water softeners. Write today. Hungerford & Terry, Inc.

WATER TREATMENT

99—See page 126. Water Treatment: Write for detailed information about solving your water treatment problems. This complete service includes each step from original survey of problem to installation of water purification equipment. General Filter Co.

100—See page 150. Oxygen Corrosion Eliminator: Santosite, maintained in boiler feed water, removes dissolved oxygen and prevents oxygen corrosion. Send for Santosite Bulletin No. 0-26. Organic Chemicals Div., Monsanto Chemical Co.

101—See page 108. Versene Test Kit: Lets you test the hardness of water in your plant in less than two minutes. Includes enough chemical to make more than 50 separate tests. Refills available. Full directions in each kit. Write today. Bersworth Chemical Company.

102—See page 130. Boiler Blowdown Equipment: Write for complete details on this compact, self-contained unit that provides fully automatic control of boiler water concentration without heat loss. Prevents priming, foaming, sludge, scale. Henszey Company.

103—See page 123. Deaerating Heater: Graver heaters are doubly guaranteed —to deliver water preheated to full steam temperature, and to reduce oxygen to less than 0.005 ml/liter. Write today for complete information. Graver has right heater for your power plant needs. Graver Water Conditioning Co.

104—See page 9. Filming Amines: Send for Technical Paper #120, "How Filming Amines Prevent Steam and Return Line Corrosion". Achieves as high as 99 percent reduction in corrosion rate! Write today. W. H. & L. D. Betz.

105—See page 2. Water Deionizer: Detailed information available on single tank "monobed" deionizer that slashes costs of high quality demineralized water. Insures freedom from scale, corrosion. Write today. Elgin Softener Corporation.

106—See page 31. Cuno Flo-Klean Filter: Makes raw water suitable for many plant services, keeps recirculated water clean, pays for itself in quick time. Write today or send coupon for full information. Cuno Engineering Corporation.

107—See page 61. Water Conditioning System: Write for full facts concerning this system that gives you all the heating, chemical feeding and clarification facilities for optimum water conditioning results. Ask for Bulletin W-212-B5. Worthington Pump and Machinery Corp.

108—See page 6. Boiler Water Comparators: Low cost, extreme accuracy, simple operation make Taylor Comparators ideal instruments for all plants. Write for free booklet. W. A. Taylor and Co.

WELDING EQUIPMENT

109—See page 44. Welding Equipment: Write today for details of new, money-saving oxygen and acetylene supply plan plus complete line of quality welding and cutting apparatus. Linde Air Products Company.

MISCELLANEOUS

110—See page 109. Check This Economy Move: Over 1900 firms supply more than 33,000 products which Hajoca stocks for industry. Use this one source and eliminate your high cost of dealing with many sources of supply for the industrial products you use. Hajoca Corp.

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers or letters of the paragraphs describing the items you want in the spaces provided on cards.

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Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

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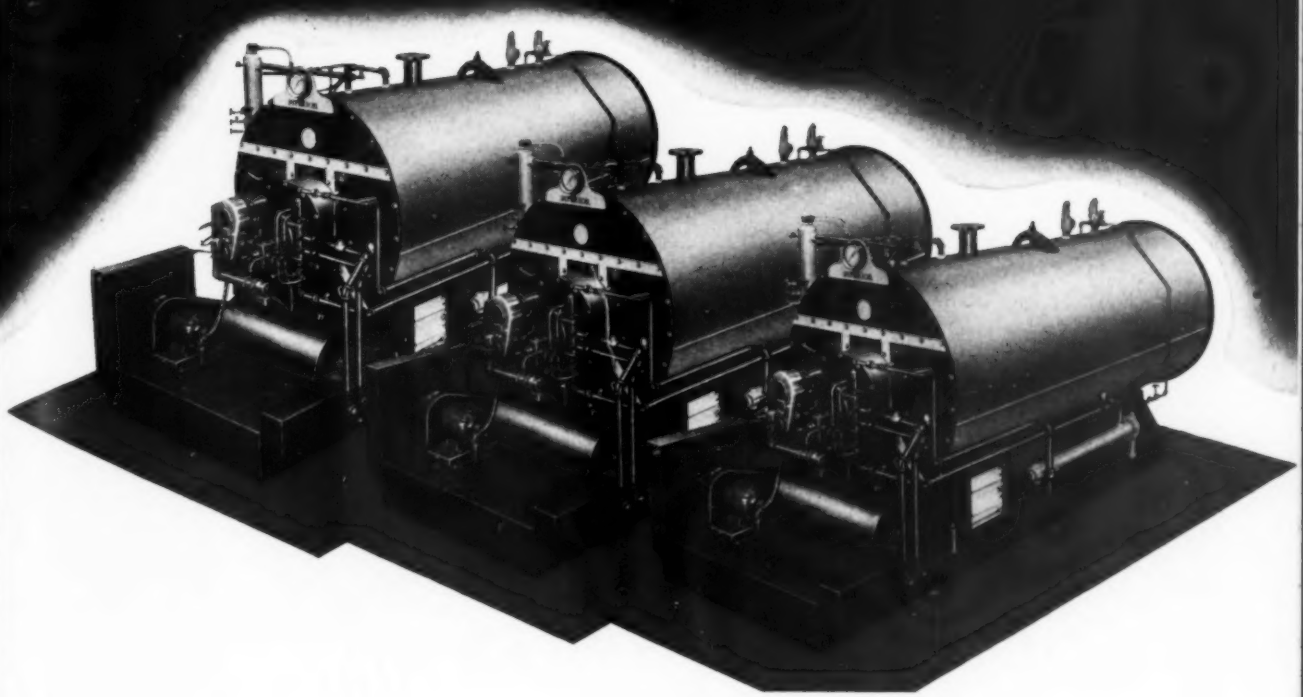
Superior

STEAM GENERATORS



Battery installations of Superior Steam Generators provide extreme flexibility to meet the most widely fluctuating steam demands. A hospital installation illustrates the point.

From early June through September, steam demand is limited to the needs of hot water and sterilization. Any one of the three units carries this load with ease . . . and at higher efficiency than could be obtained by minimum operation of a larger boiler.

When cold weather adds its heating load, a second Superior Steam Generator is fired. Only the most severe weather demands firing the third unit . . . which throughout the rest of the year provides stand-by equipment which is desirable in any operation.

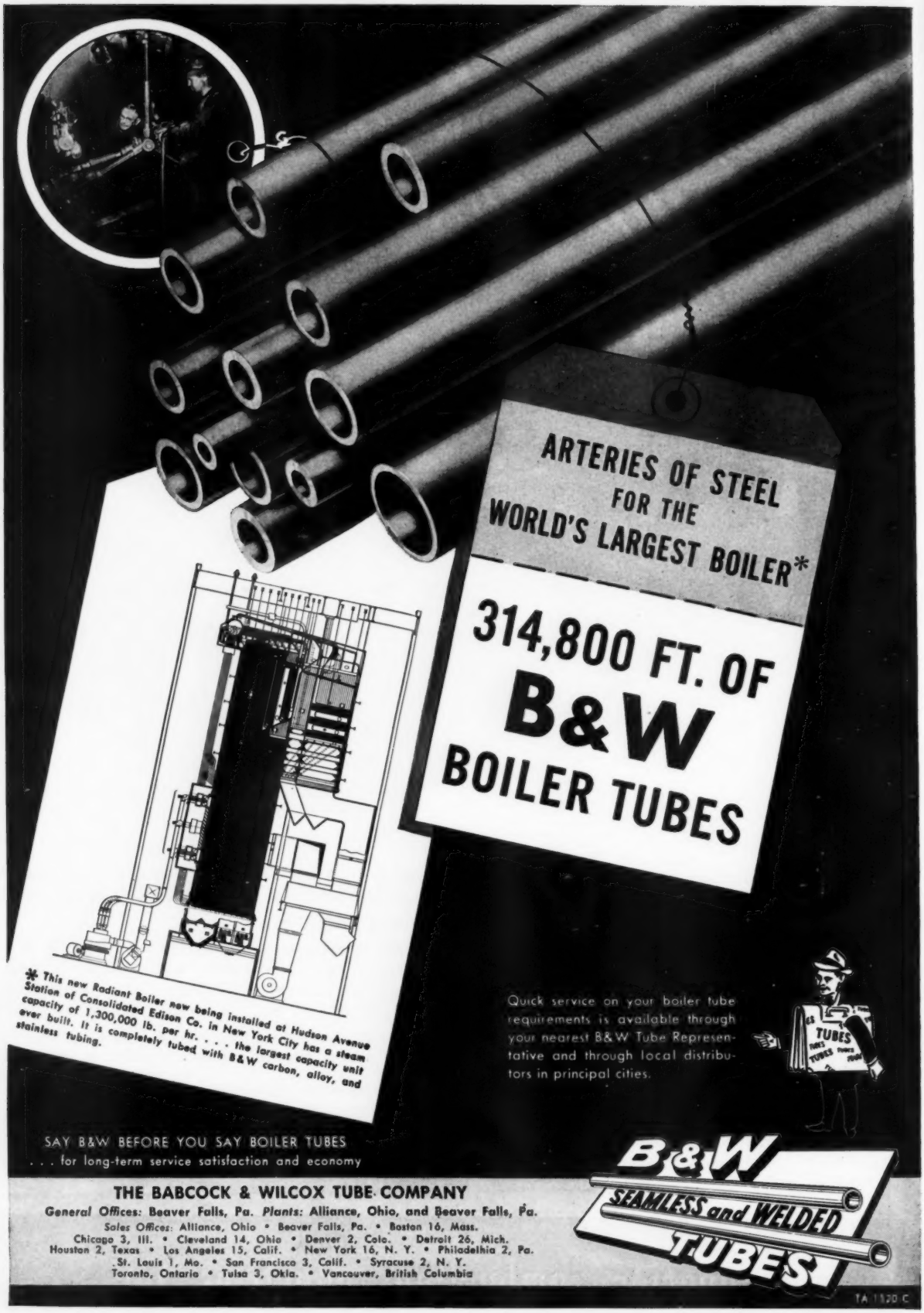
By employing different combinations of the three, (7 in all) allowing each unit in turn to share the load; all enjoy longer life at maximum efficiency . . . and by using only the number dictated by the steam demand, maximum economy at every stage of steam demand is assured.

Let us show you how battery installation can serve you better in your new plant . . . or augment your present steam facilities.

Write today for Catalog 202

uperior ombustion ndustries, inc.

Factory: Emmaus, Pa.
Executive Offices: Times Tower, Times Square, New York 18, N. Y.


ARTERIES OF STEEL
FOR THE
WORLD'S LARGEST BOILER*
314,800 FT. OF
B&W
BOILER TUBES
* This new Radiant Boiler now being installed at Hudson Avenue Station of Consolidated Edison Co. in New York City has a steam capacity of 1,300,000 lb. per hr. . . . the largest capacity unit ever built. It is completely tubed with B&W carbon, alloy, and stainless tubing.
Quick service on your boiler tube requirements is available through your nearest B&W Tube Representative and through local distributors in principal cities.
TUBES
SAY B&W BEFORE YOU SAY BOILER TUBES
. . . for long-term service satisfaction and economy
THE BABCOCK & WILCOX TUBE COMPANY
General Offices: Beaver Falls, Pa. Plants: Alliance, Ohio, and Beaver Falls, Pa.
Sales Offices: Alliance, Ohio • Beaver Falls, Pa. • Boston 16, Mass.
Chicago 3, Ill. • Cleveland 14, Ohio • Denver 2, Colo. • Detroit 26, Mich.
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St. Louis 1, Mo. • San Francisco 3, Calif. • Syracuse 2, N. Y.
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B&W
SEAMLESS and WELDED
TUBES
TA 1120 C

It's an "open and shut" case for flexible connectors

This tire re-capping machine opens and closes all day long. American Seamless Flexible Metal Tubing carries the hot steam in and out under pressure—safely, dependably, despite repeated flexing.

It's another example of how American Seamless Flexible Metal Tubing meets every requirement of the ideal flexible connector:

Seamless; leakproof
Pressure-resistant
Fatigue-resistant
Easy to connect

American Bronze Seamless Tubing carries steam to and from this automobile tire re-capping machine made by James C. Heintz & Company, Inc., Cleveland, O.

American Seamless Flexible Metal Tubing and American Flexible Metal Hose are made in a wide variety of styles and metals for conveying liquids, many chemicals, gases and semi-solids, under severe conditions of temperature, pressure and mechanical stress ... for protecting wiring and flexible driveshafts ... for connecting misaligned piping or ports.

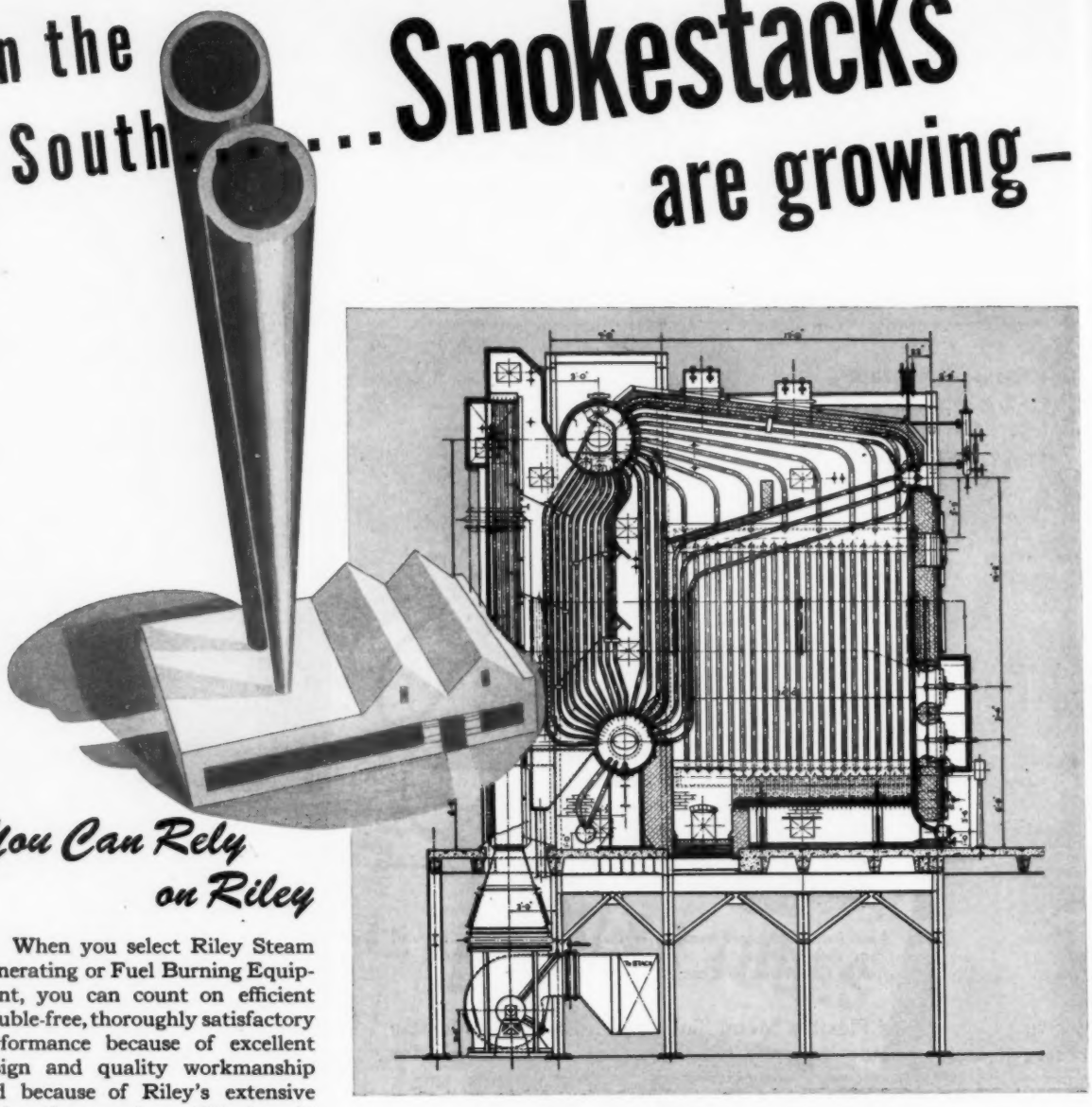
If your equipment requires movable connectors, let us send you the complete story on American Flexible Metal Hose and Tubing, or let our Technical Department make recommendations. Write to The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada, The Canadian Fairbanks-Morse Co., Ltd.

ANACONDA
from mine to consumer

wherever connectors must move ... American

FLEXIBLE METAL HOSE AND TUBING

In the South . . . Smokestacks are growing—



You Can Rely on Riley

When you select Riley Steam Generating or Fuel Burning Equipment, you can count on efficient trouble-free, thoroughly satisfactory performance because of excellent design and quality workmanship and because of Riley's extensive engineering experience. Riley's rapid growth has resulted from the outstanding performance of their equipment. Every user of Riley equipment will assure you, "you can rely on Riley."

75,000 lbs./hr. Riley Steam Generating Unit
Masonite Corporation, Laurel, Miss.

Masonite started to use Riley boilers in 1939. Since that time Masonite has placed six different orders with Riley for seven Riley boilers with a steam capacity of 415,000 lbs. Mr. E. C. Grady, Plant Engineer, will gladly tell you of their experience with Riley boilers.

TRADE MARK Rx REGISTERED

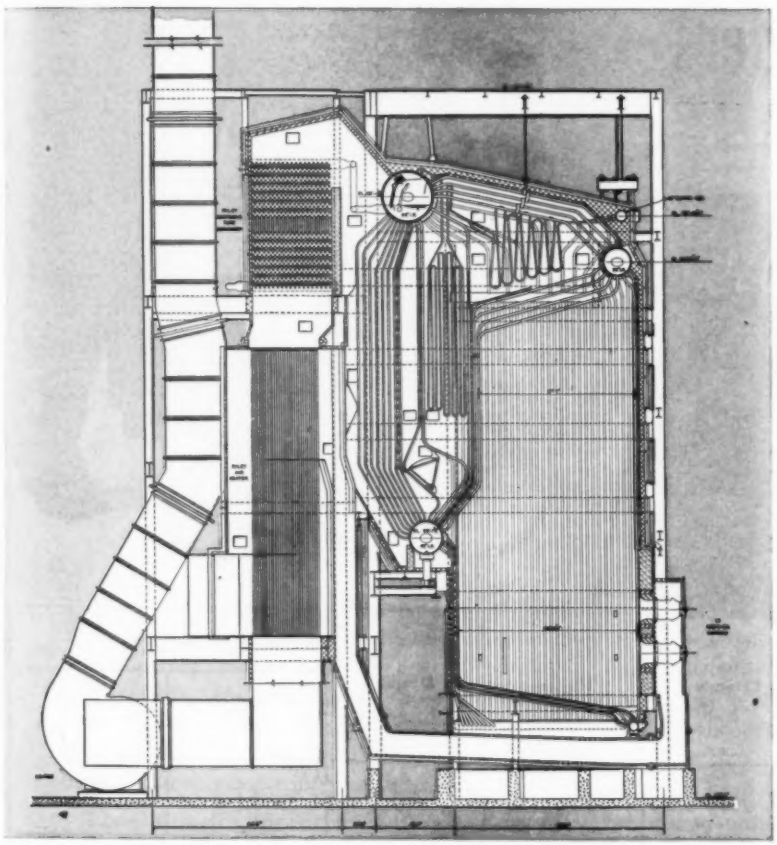
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans Memphis St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

and you will find Riley Steam Generating Units under many of the recent ones!



Houston Lighting and Power Company, one of the largest Southern Public Utility companies is another good Riley customer. Since 1938 Houston has ordered only Riley boilers — 8 different orders for 9 large Riley Steam Generating Units — having a steam capacity of over four and a half million pounds of steam an hour. Conclusive evidence of the complete satisfaction obtained with Riley equipment.

All these well-known Southern plants use **RILEY** *boilers*

Southern Industrial Plants

Dow Chemical Co., Freeport, Texas
Gaylord Container Corp., Bogalusa, La.
Champion Paper & Fibre Co., Canton, N. C.
Savannah Sugar Refining Co., Savannah, Ga.
Crown Cork & Seal Co., Baltimore, Md.
Godchaux Sugars, Reserve, La.
Southern Alkali Corp., Corpus Christi, Texas
Mead Corp., Sylvia, N. C.
Celanese Corporation of America, Narrows, Va.
Celanese Corporation of America, Bishop, Texas
Celanese Corporation of America, Rock Hill, S. C.
Celanese Corporation of America, Hopewell, Va.
Celanese Corporation of America, Cumberland, Md.
Ecusta Paper Co., Pisgah Forest, N. C.
Masonite Corporation, Laurel, Miss.
Commercial Solvents Corp., Sterlington, La.
Riegel Textile Corp., Ware Shoals, S. C.
Calco Chemical Co., Piney River, Va.
International Harvester Co., Louisville, Ky.
Humble Oil & Refining Co., Baytown, Texas
Congoleum Nairn Co., Cedarhurst, Md.
Mathieson Alkali Co., Lake Charles, La.
Revere Copper & Brass Co., Baltimore, Md.
Standard Oil Co. of La., Sterlington, La.
Lone Star Steel Co., Daingerfield, Texas
Park & Tilford, Inc., Midway, Ky.
Alamo Refining Co., Sweeny, Texas
Republic Creosoting Co., Norfolk, Va.
U.S. Gypsum Co., Plasterco, Va.
Brown & Williamson Tobacco Co., Petersburg, Va

Southern Public Utility Plants

South Carolina Power Co., Charleston, S. C.
Mississippi Power Co., Hattiesburg, Miss.
Arkansas Power & Light Co., Little Rock, Ark.
New Orleans Public Service Co., New Orleans, La.
Northern Virginia Power Co., Winchester, Va.
Gulf Power Co., Pensacola, Fla.
Florida Power & Light Co., Lauderdale, Fla.
Carolina Power & Light Co., Moncure, N. C.
Southwestern Public Service Co., Borger, Texas
Houston Lighting & Power Co., Houston, Texas

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in ... costs

COMPLETE STEAM GENERATING UNITS

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD ... AIR HEATERS

... it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

LINDE Oxygen and PREST-O-LITE Acetylene in Handier Cylinders

LINDE Trade-Mark

PREST-O-LITE Trade-Mark

PORTABILITY PLUS!

convenient
lightweight
easy to use
easy to move

	Style	Capacity cu. ft.	Height in.	Diam. in.	Weight	
					Full lb.	Empty lb.
Oxygen	Q*	80	35	7⅛	67	60
Acetylene	WQ	60	24¾	7¾	55	51

*In some areas, Style XL, 70 cu. ft.

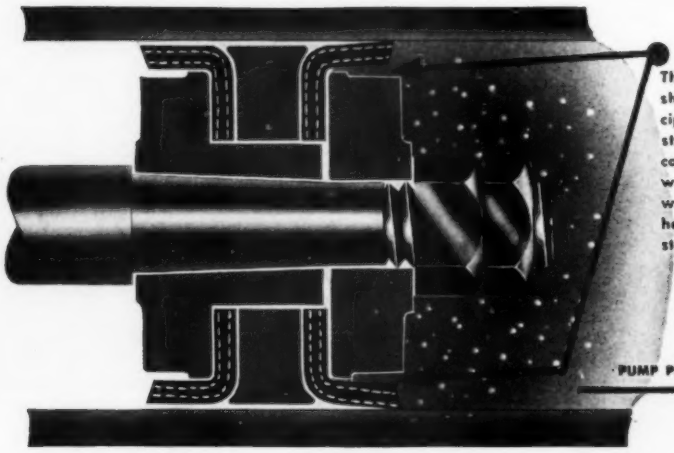
ORDER FROM YOUR

Linde Trade-Mark

DISTRIBUTOR

Ask your local LINDE distributor for details of new, money-saving oxygen and acetylene supply plan —or phone him for prompt service on a complete line of quality welding and cutting apparatus, rods, supplies, and accessories. The Linde Air Products Company, 30 East 42nd Street, New York 17, N. Y. In Canada: Dominion Oxygen Company, Limited, Toronto.

The terms "Linde" and "Prest-O-Lite" are registered trade-marks of The Linde Air Products Company, a Unit of Union Carbide and Carbon Corporation.



This greatly exaggerated diagram shows the Darcova Pumcup principle. On pressure side of each piston stroke, flexible Pumcup is automatically forced against liner or cylinder wall. Firm, uniform contact all the way around eliminates slippage, holds volumetric efficiency at constant high in spite of gradual wear.

PUMP PISTON MOTION

THEY NEVER RELAX
when the pressure is on!

HERE is a piston packing that actually takes *advantage* of the fluid pressure built up in reciprocating pumps and in air or hydraulic mechanisms. The illustration above shows how Darcova Pumcups utilize this pressure . . . how they hug the cylinder wall on every work-stroke of the piston, preventing needless slippage.

Then, too, friction between the Pumcup and cylinder is automatically "pressure-equalized" all the way around for a uniformity of wear otherwise impossible. And, in contrast to other types of packing, fluid slippage does not increase with wear. Peak volumetric efficiency is retained even when Pumcup wear is far advanced.

Consequently, Pumcups offer two mighty important advantages. First, downtime and material and maintenance costs are cut to a fraction because Pumcups outlast other types of packing many times over. Secondly, volumetric efficiency is held constant.

Everything considered, it is easy to see how thousands of Darcova Pumcup users are saving up to $100 per pump per year. Easily installed, Pumcups replace ordinary packing in reciprocating pumps and in air or hydraulic mechanisms. They are precision built in ½ to 42 inch sizes and in many different textures for practically all fluids, pressures and temperatures.

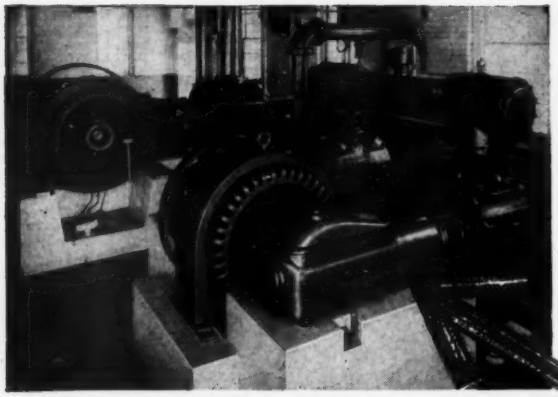
DARCOVA
THE ORIGINAL COMPOSITION CUP

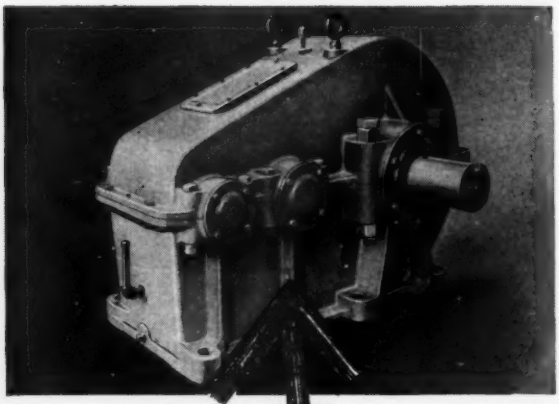
***FREE BULLETIN**—For a free bulletin containing complete information, write, or use the coupon below.*

DARLING VALVE & Manufacturing Co.
WILLIAMSPORT, PA.

Darling Valve & Mfg. Co., Williamsport 9, Pa.
Please send me the free bulletin checked below:
☐ No. 4401 Darcova Pumcups for reciprocating pumps.
☐ No. 4502 Darcova Pumcups for air or hydraulic mechanisms.

Name_____
Company_____
Address_____
City_____ State_____





For the best lubrication use SINCLAIR RUBILENE

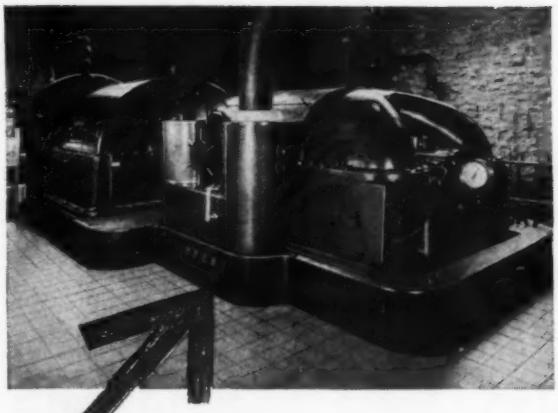
Over many years engineers in power plants throughout the country have accepted Sinclair's Rubilene as the finest available lubricant for power house equipment.

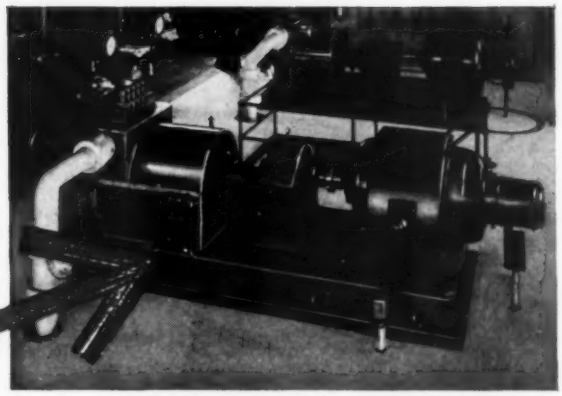
Sinclair Rubilene has always been a top-quality oil, as it has been constantly improved through the years, incorporating the latest technological developments in refining and processing. It resists oxidation under continuous high temperatures, and recirculation. It separates rapidly from water and is non-foaming. Through long periods of use it retains its original qualities, providing uniform, trouble-free lubrication and low maintenance costs.

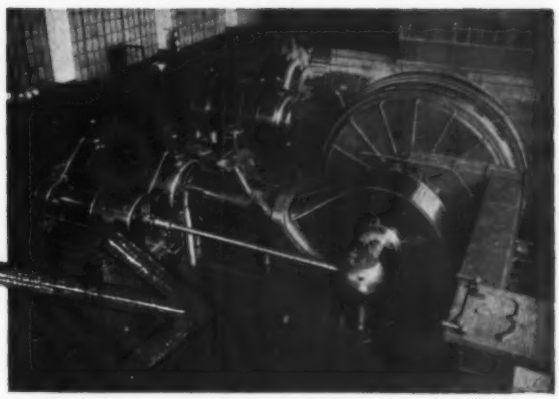
Yes... Rubilene's finer quality pays dividends in the power plant.

SINCLAIR

For lubrication counsel . . . see your nearest

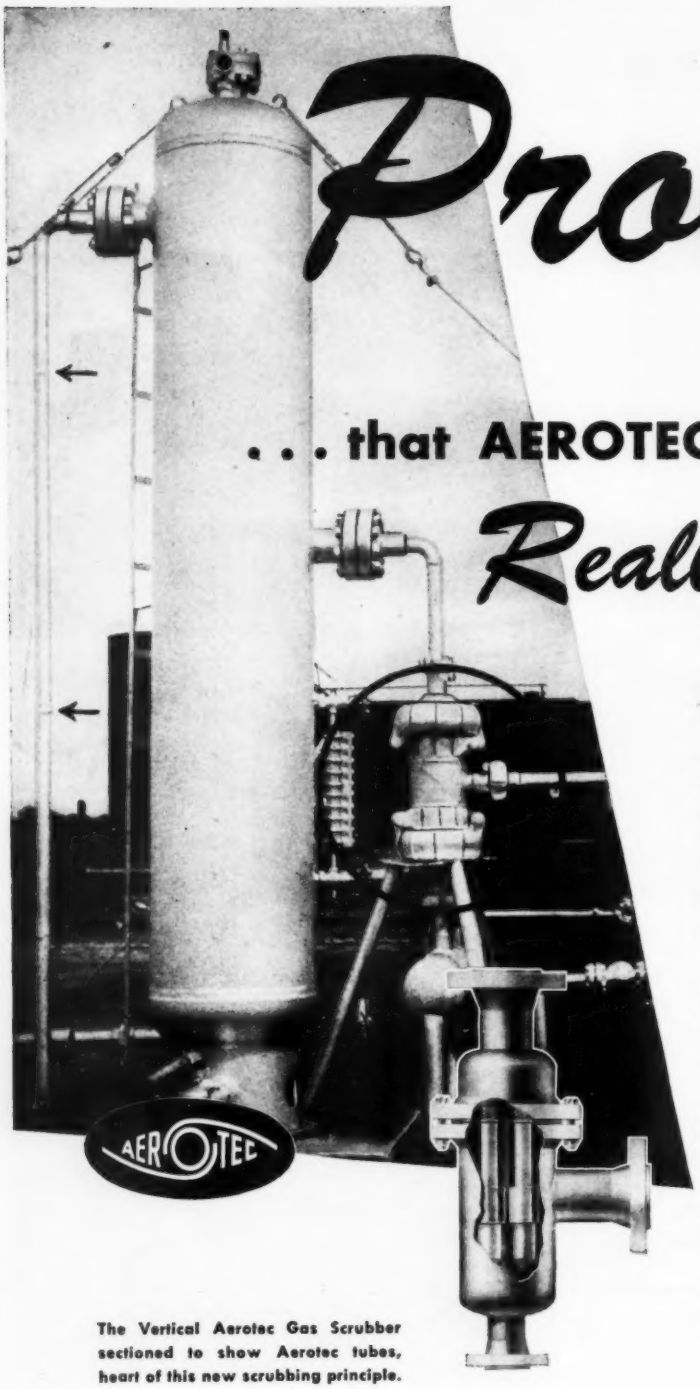






REFINING COMPANY

Supplier of Sinclair Products or write to Sinclair Refining Company, 630 Fifth Ave., New York 20, N. Y.



The Vertical Aerotec Gas Scrubber sectioned to show Aerotec tubes, heart of this new scrubbing principle.

Proof

. . . that AEROTEC GAS SCRUBBERS *Really* clean gas

This pilot installation at Alice, Texas, used on very dry gas, was first installed on the discharge of a conventional type gas scrubber (position of first installation shown by arrows). In 18 hours of operation, this Aerotec unit collected 2 quarts of liquid, from gas that had passed through the conventional unit.

Installed at the inlet to the conventional gas scrubber, only one teacup of fluid was collected from the conventional type in 8 days, and this was probably condensation.

This is a typical example of field reports on the high efficiency of Aerotec gas scrubber units. Based on a modification of the principle of separation used in dust collection, Aerotec units have produced outstanding results, both at the well and on pipeline applications.

A catalog on operating and application data will be sent on request. Just write our Project Engineers, or the field office nearest you.

Project and Sales Engineers

THE THERMIX CORPORATION

Greenwich, Connecticut

(Offices in 28 Principal Cities)

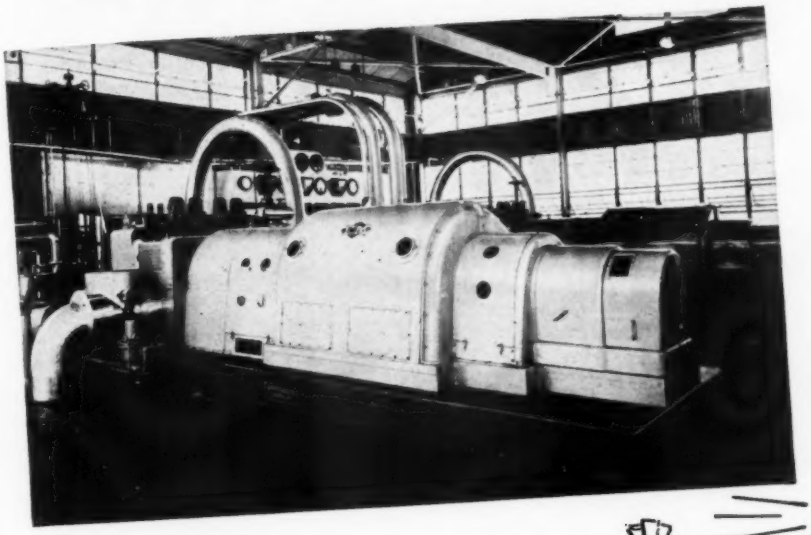
Canadian Affiliates: T. C. CHOWN, LTD., 1440 Saint Catherine St., W., Montreal 25, Quebec; 50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.

HANDLING TWO JOBS AT ONCE...

and saving money on both!



Two 1500 KW Worthington turbine-generators, installed in the Eunice, N. M. plant of the El Paso Natural Gas Company. These are non-condensing extraction turbines designed to operate on initial steam conditions of 575# — 575° FTT exhausting at 5#G back pressure.

Worthington Turbine-Generators Selected By Natural Gas Firm For Both Power and Product-Conditioning

Pumping natural gas from southeastern New Mexico and the Texas Panhandle to points in California and Arizona, the El Paso Natural Gas Company uses Worthington Turbine-Generators for double duty. Besides furnishing electricity for the company's plant in Eunice, N. M., the turbines automatically extract steam at 125#G for heating Amine solution, which is mixed with the gas to remove impurities.

In every branch of industry, users are getting daily proof of the outstanding flexibility of Worthington Turbine-Generator Sets — not only as sources of more dependable, more economical electric power, but as cost-cutting suppliers of processing steam for many important allied purposes.

WORTHINGTON TAKES ALL THE RESPONSIBILITY

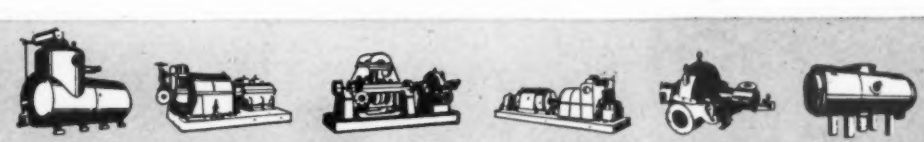
Worthington builds Turbine-Generator Sets in sizes up to 10,000 kw, and in all types. Each is designed to make steam do more work, and each is backed by Worthington's undivided responsibility for the complete unit's design, assembly and performance. For expert aid in selecting the *right* size and type for your own requirements . . . and further proof that *there's more worth in Worthington* . . call our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

WORTHINGTON

STEAM TURBINES

T.O.-9

A GREAT TEAM IN STEAM



Feed Water Heaters | Multi-Stage Turbines | Boiler Feed Pumps | Turbine-Generator Sets | Single-Stage Turbines | Surface Condensers

MAINTENANCE-FREE

pipe line motion control is yours

...with CMH EXPANSION JOINTS

There's no longer any need to spend time and money on periodical maintenance of expansion joints. You can install CMH corrugated expansion joints and forget them . . . there's no packing to pull up or replace. In CMH expansion joints, the curvature of corrugations serves to minimize internal stresses and to provide balance of working stresses. This design coupled with advanced forming methods developed through years of research and experience assures long, trouble-free service. For a new installation or for replacement of obsolete equipment, specify CMH expansion joints for the practical, dependable answer to control of axial, lateral or radial motion in piping.

The illustrations show three typical installations of CMH Controlled-Flexing Expansion Joints.

A CMH TYPE to meet every need

CMH EXPANSION JOINTS are made as Free-Flexing for pressures up to 30 psi, Controlled-Flexing for pressures up to 300 psi and Flexoniflex for pressures up to 1500 psi, temperatures to 1600° F. Sizes range from ⅜" to 30" I. D. and larger. Available in copper, stainless steel or other alloys with flanged or welding ends.

Flexon identifies CMH products that have served industry for over 48 years.

CHICAGO METAL HOSE Corporation

1335 S. Third Avenue • Maywood, Illinois • Plants at Maywood, Elgin and Rock Falls, Ill.
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ont.

CMH

ONE DEPENDABLE SOURCE
for every flexible metal hose requirement

Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems • Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

"HOTTER, SOONER" Saves YOU MONEY

Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster.* Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load* . . . discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

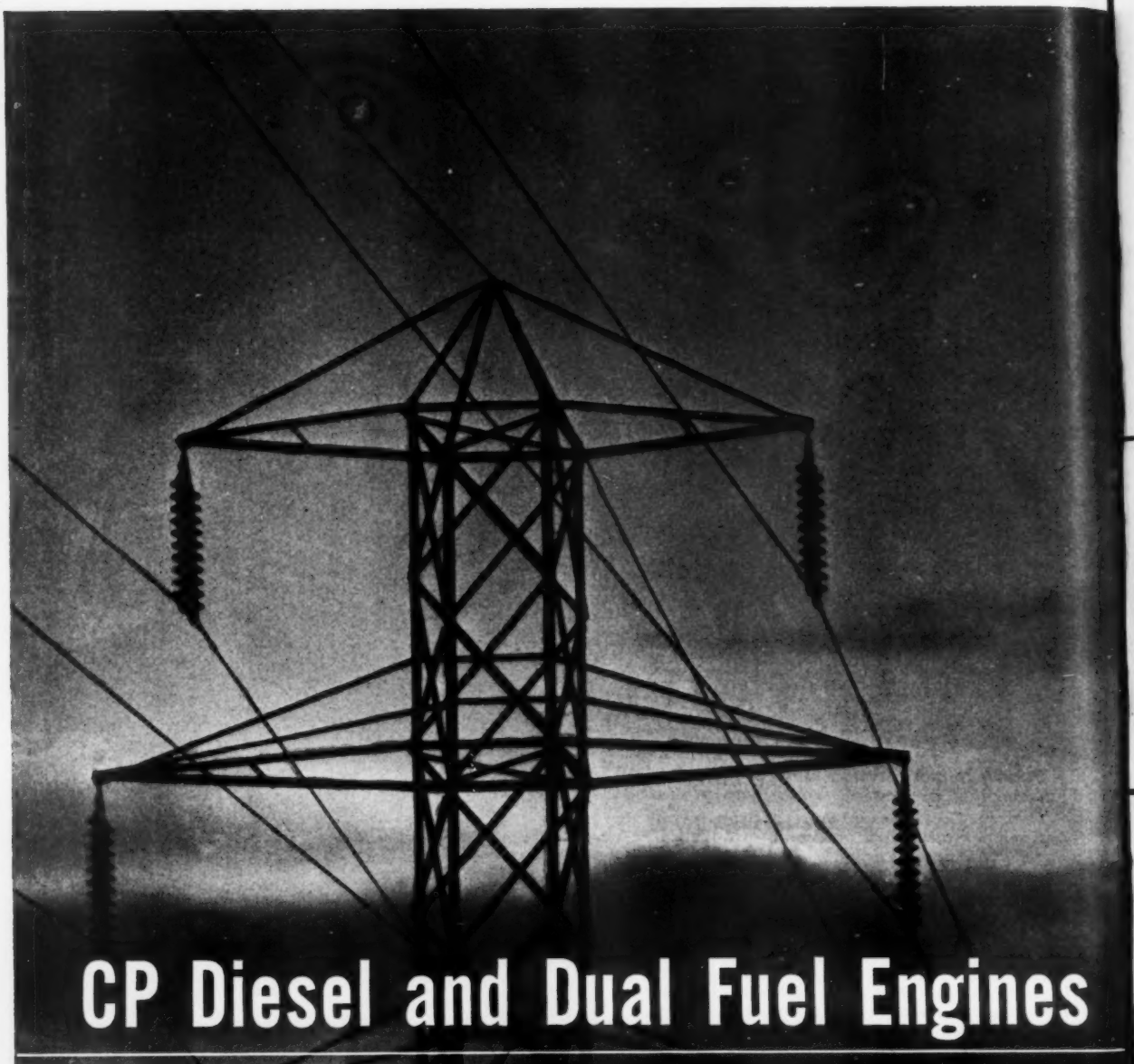
Try a Yarway today . . . standardize on Yarways tomorrow.

YARNALL-WARING COMPANY
109 MERMAID AVENUE, PHILA. 18, PA.

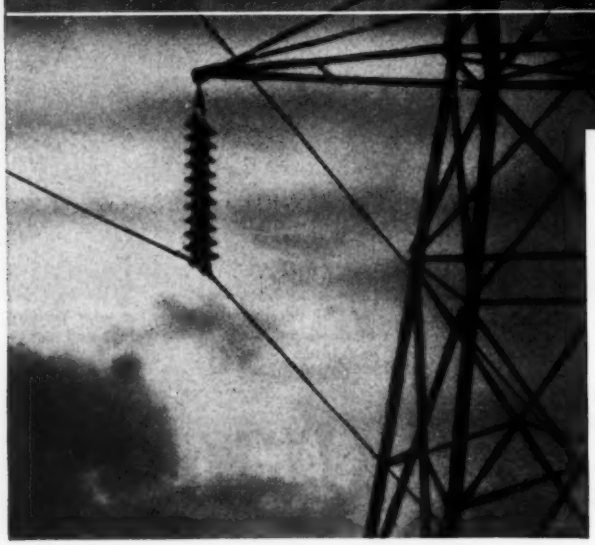
Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

Stainless Steel Body

YARWAY IMPULSE STEAM TRAP



CP Diesel and Dual Fuel Engines

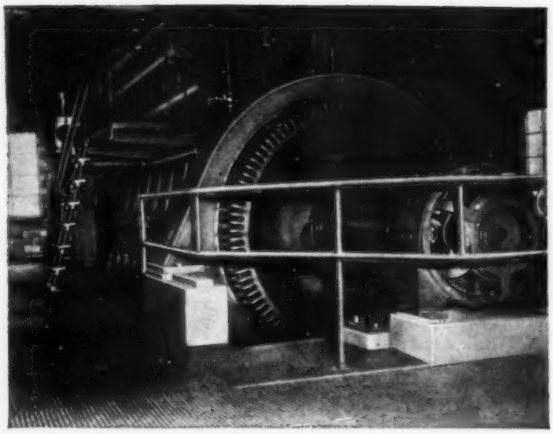


for every Public Utility purpose

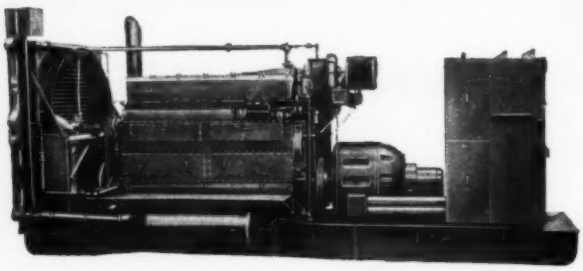
Available in sizes from 120 to 1750 horsepower, CP engines can be furnished either for straight Diesel or Dual Fuel operation. The CP line includes both normally aspirated and supercharged engines, all the latter incorporating the thoroughly dependable Elliott-Buchi Turbo-charger.

The engines illustrated are typical of many CP installations in public utility service.

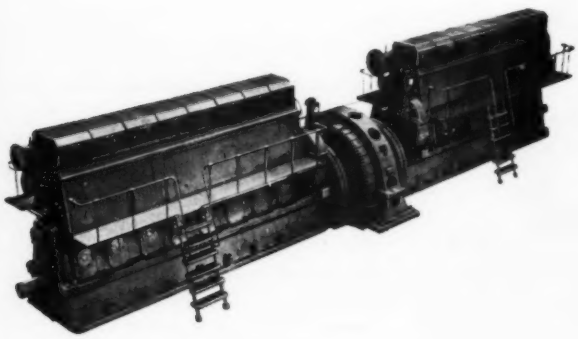
Write for further information



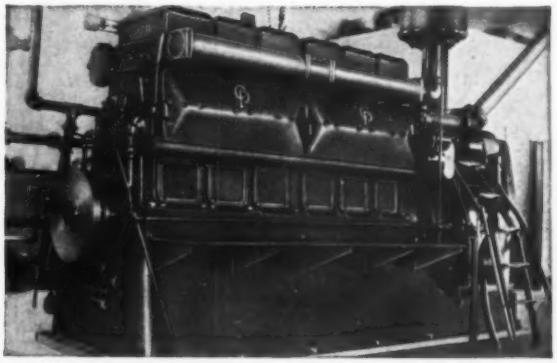
1650-hp Dual Fuel Generator unit in public utility plant – 327 rpm, 1150 kw.



500-kw CP Portable Generator unit for public utility emergency service.



Twin Engine Generator unit rated 2250 hp, 1500 kw.



A 175-kw Diesel Electric unit in a prominent utility plant, with more than 14,000 hours service to date.

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

doing this *costs more* now!

You do it less often

by using Dependable Quality

CRANE VALVES

That's why more Crane Valves are used than any other make

. . . this valve likes tough throttling jobs

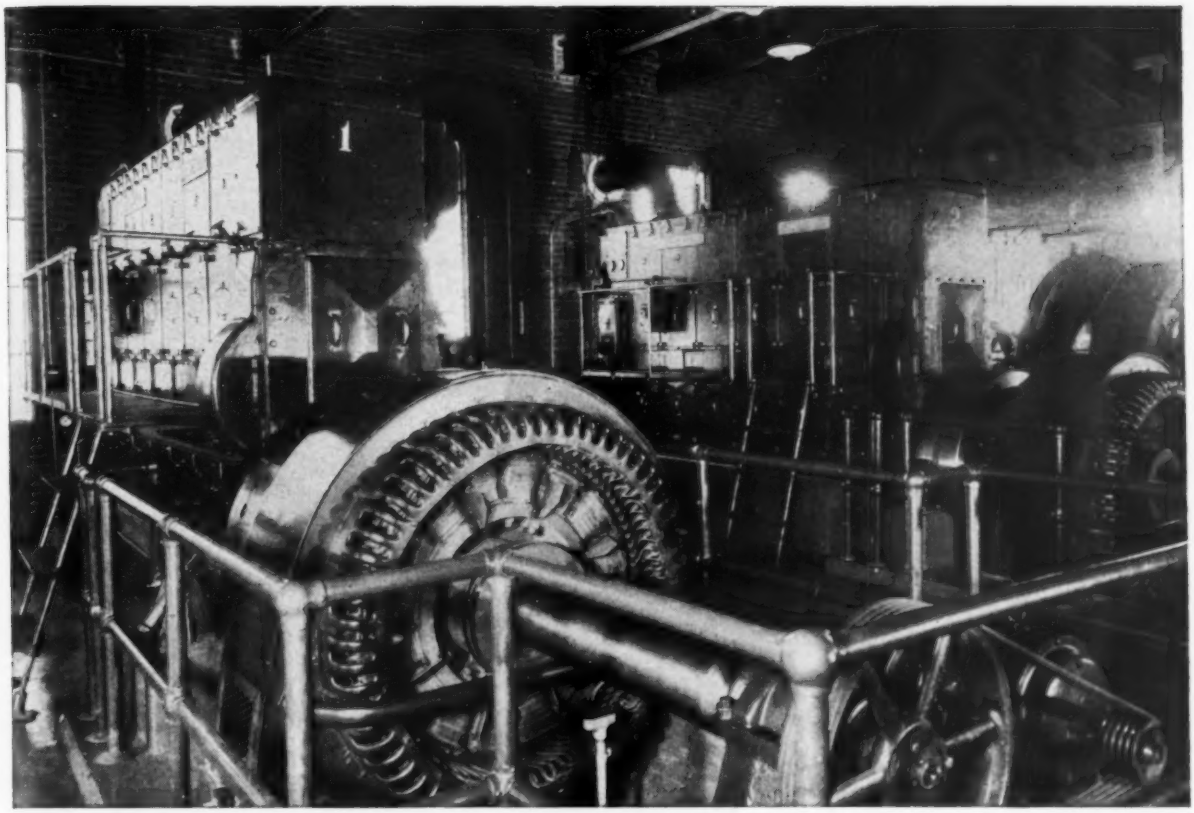
—And for durable, maintenance-free service, it's typical Crane quality. The plug-type disc and seat construction in Crane No. 14½P's utilizes the toughest combination of metals found in 150-Pound brass valves. Extra wide seating surfaces give high resistance to damage by "wire drawing" or foreign matter. Crane disc taper is precisely correct for accurate flow regulation.

Whether you need throttling valves or any other type, you'll pay less in the long run by insisting on Crane Quality. Get a demonstration by your Crane Representative.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



These Superior Engines Saved $20,000 Operating at 40% Capacity

In an Illinois town two Superior Dual Fuel engines have slashed electrical power costs. And it was done under adverse operating conditions.

Two identical turbocharged Dual Fuel Superior Diesels were fitted into the old steam generator building without disrupting service. And because the city fathers wanted ample capacity for supplying future current requirements, they purchased large units that would operate initially at partial loads.

In spite of the fact that this load factor averaged less than 40%, these two Superior Diesels saved $20,000 in their first year of operations. When natural gas becomes available soon, it is estimated that savings will increase an additional $10,000 a year.

If you're looking for ways to cut power costs or increase generating capacity, it will pay you to talk to a Superior representative. One will be glad to call on you at any time—just name the date. And, of course, we'll be glad to send you a copy of our new, fully illustrated booklet, *Superior Diesel For Stationary Application.*

THE NATIONAL SUPPLY COMPANY
SUPERIOR ENGINE DIVISION
Plant and General Sales Office: Springfield, Ohio

THE NATIONAL NSCO SUPPLY COMPANY

Superior DIESELS

Locomotive · Marine · Oil Field · Stationary

STOP Destructive Pipe-Line Stresses

with CHAPMAN TILTING-DISC CHECK VALVES

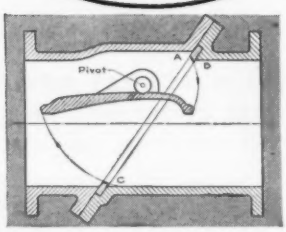
When you reduce slamming you reduce the hazard of rupturing pipe lines, opening up joints . . . . a host of maintenance problems.

That is why we suggest you investigate Chapman Tilting-Disc Check Valves. The balanced disc in this unusual valve lifts away easily in opening . . . rides smoothly on the flow . . . closes quickly but quietly. There's no slamming . . . minimum wear on valve parts and minimum stresses on pipe lines.

Special designs with dashpots are also available for use under unusual operating conditions, where no self-acting Check Valves can function satisfactorily.

Made in both iron and steel . . . pressures up to 3000 pounds.

You'll find it will pay you to write today for more information on this valve developed by Chapman. Request Bulletin #30.



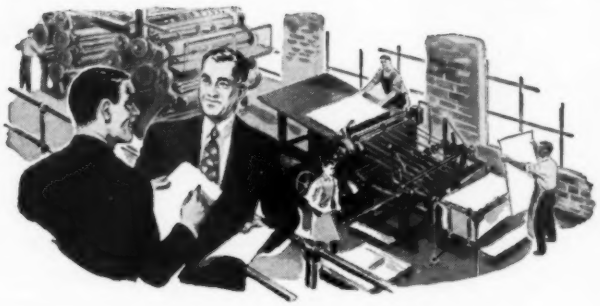
Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co.

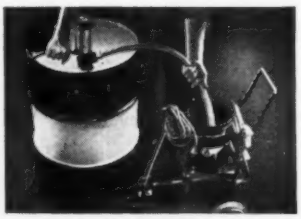
INDIAN ORCHARD, MASSACHUSETTS

How to save $4247 a year

by investing only $2471!

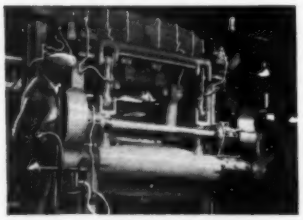


Alemite Cuts Costs 3 Ways



1. ***In Transferring Lubricants...*** by eliminating mess, expensive contamination—and cutting man hours 63% for every 100 pounds of lubricant transferred.

2. ***In Loading Grease Guns . . .*** by saving 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. ***In Applying Lubricants . . .*** by saving up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

It all started with a test on a single mammoth high speed machine, in a Chicago plant* where machine break-downs and bearing replacements were frequent, stock spoilage and rejects were high, and oil consumption ran to $5664 a year!

After a month's test of Alemite Centralized Lubrication on this one machine, the system was installed on all five other machines in the plant at a total cost of only $2471. Since that time, there has not been a single break-down or bearing loss, stock spoilage and rejects have been greatly reduced, and lubricant cost has been cut to $1417! This is an annual saving of $4247, *in addition* to more production gained from each machine, and a marked product improvement for increased customer satisfaction!

No matter what size or type of plant you operate, an Alemite Lubrication Engineer can show you dozens of ways of making worthwhile savings through more efficient handling of petroleum products. These are facts which you can readily confirm in your own time studies. The Alemite man will cooperate fully with your plant engineers in setting up a test. Contact your local Alemite Industrial Distributor now. Or send for free booklet "11 Ways to Cut Production Costs." Mail coupon below to Alemite, Dept. A-00, 1850 Diversey Parkway, Chicago 14, Illinois.

**Name on request.*

ALEMITE

MEANS EVERYTHING FOR LUBRICATION

1. Methods 2. Lubricants 3. Equipment

Another Product of Stewart-Warner

FREE! New Booklet

"11 Ways to Cut Production Costs"...

(simply attach to your letterhead)

Alemite, Dept. **M-100**
1850 Diversey Parkway, Chicago 14, Ill.

Please send me without charge or obligation your booklet "11 Ways to Cut Production Costs."

*Name*_____

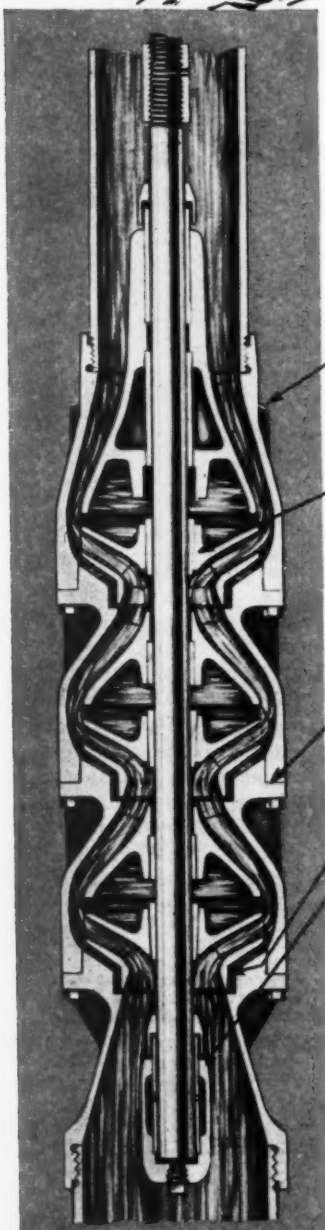
*Company*_____

*City*_____ *State*_____

RE-DESIGNED . . . for a new high in Pumping Performance!

Worthington Type Q Vertical Turbine Pumps Climax Many Years of Continuous Development

Only the longest and broadest experience in the field could produce the Worthington Type Q Vertical Turbine Pump. New and exclusive casting methods, hydraulic and dynamic balanced impellers, and greatly improved bronze bearings are among the many features combining to give you the most efficient pumping performance at lowest possible cost.



Water-lubricated model illustrated

BOWL DESIGN-DETAILS

1. Discharge bowl construction of advanced type, providing most efficient conversion from velocity to pressure as liquid enters column. Oil-lubricated model includes new double-sealed construction for maximum protection.

2. Having made both enclosed and semi-open impellers for many years, Worthington now standardizes on enclosed. Advantages: up to 50% less down thrust . . . lighter loading of the thrust bearing and less shaft elongation, reducing sensitivity to changes in vertical clearance . . . elimination of extremely close vertical adjustment in the field.

3. Flanged type bowls for tighter joints, less corrosion, easier assembly, better alignment.

4. Renewable bronze wearing rings standard on all sizes except 6".

5. Large diameter shafts and extra long bronze bearings with sand collars at both ends of bowl assembly maintain rotor alignment, prevent vibration, assure longer life.

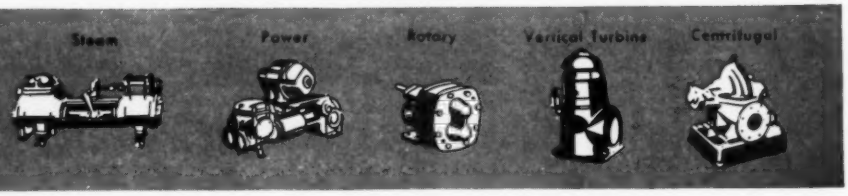
Available in sizes from 6" to 32", water- or oil-lubricated, Worthington Type Q Vertical Turbine Pumps handle liquids at temperatures of 7° below zero F to 500° F *with maximum head per stage over the entire size range.*

Contact your local Worthington dealer for the whole story that proves *there's more worth in Worthington.* Complete manufacturing and servicing facilities at Denver, Colo., and Harrison, N. J. *Worthington Pump and Machinery Corporation, Harrison, N. J.; Denver 16, Colorado.*

WORTHINGTON

DO.3

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB



GET longer wear with R/M NO. 920 the flexible metallic packing

R/M No. 920 is one of several R/M metallic packings that combine long-wearing quality with an anti-frictional surface that preserves rod or shaft. R/M No. 920 is made of asbestos yarns covered with metal foil, a combination that is highly resilient and flexible. Recommended for steam and air rods, centrifugal pump shafts, valve stems, expansion joints, and applications where temperature does not exceed 450°F. and surface speed is not greater than 600 feet per minute.

For complete information about R/M No. 920 and the full line of R/M packings, see the authorized R/M packing distributor near you, or mail the coupon below.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

R/M

RAYBESTOS-MANHATTAN, INC.
Packing Division, Manheim, Pa.

Gentlemen: Please send me data on R/M No. 920. **IP-100**

Name_____

Position_____

Company_____

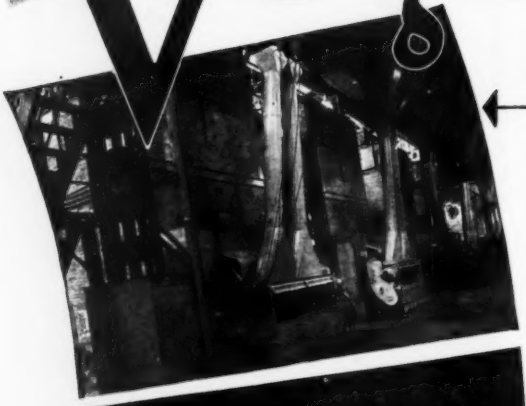
Address_____

City_____ Zone_____ State_____

USE THESE BETTER

Vogt Products

For Today's Tough Service Demands

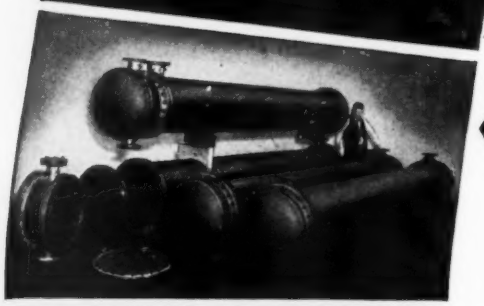


EFFICIENT AND DEPENDABLE STEAM GENERATION

Vogt steam generating units are designed to give maximum rating in a minimum of space with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels, as desired, meet every power, heating or process requirement.

PROCESS EQUIPMENT FOR EVERY SERVICE

Stills, towers, oil chilling machines, filter presses, heat exchangers, etc. are constructed to all Codes. They meet all demands for operating security and trouble-free performance and help to lower costs in important process industries around the world.

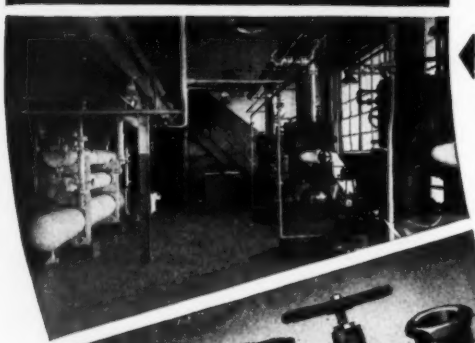


SPECIAL MATERIALS FIGHT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment made from special metals and alloys to combat corrosion, and product contamination or discoloration. Fabrication procedures employed insure that corrosion resistant properties of welds will match that of the materials from which units are constructed.

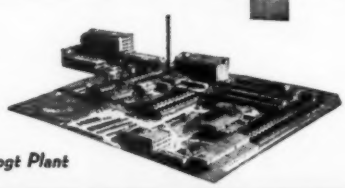
MORE TONNAGE AT LESS COST

Over 60 years of manufacturing experience, engineering and research stand behind Vogt refrigerating and ice making machinery. Absorption Systems, Compression Systems, and the Automatic Tube-Ice Machine in a wide range of capacities serve in leading petroleum refineries, chemical plants, ice and cold storage plants, dairies, packing plants, etc., at home and abroad.



DROP FORGED FOR EXTRA TOUGHNESS AND LONG-TIME SERVICE

Vogt valves, fittings and flanges, for top performance in oil, water, air, gas, and ammonia services, at high or low pressures and temperatures, are available drop forged entirely from carbon steel or stainless steel. Valves can be furnished in a combination of materials by using stainless steel for parts affected by service temperature or corrosion, and less expensive alloys or carbon steel for other parts.

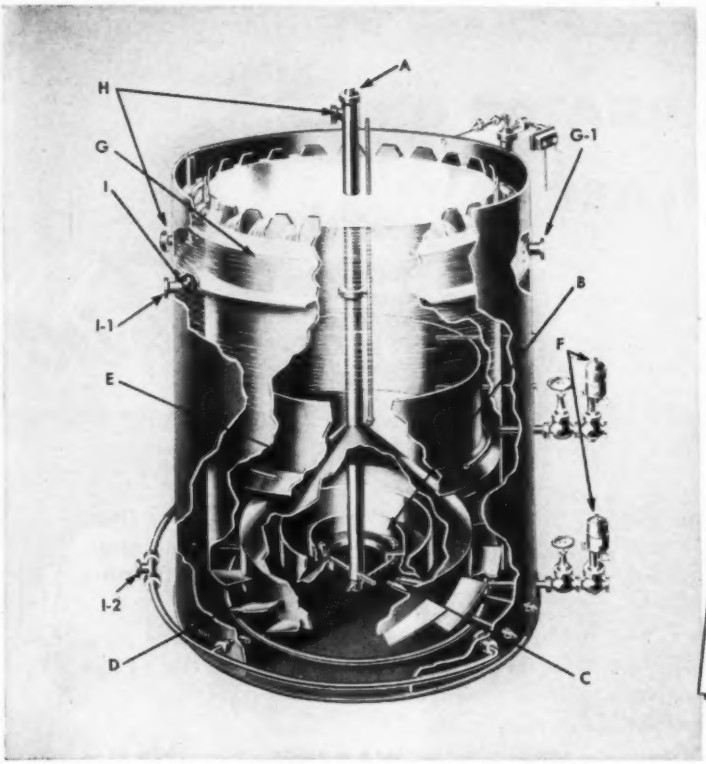


Air View of Vogt Plant

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS



Vortex mixing eliminates need for submerged moving parts in the Worthington Cold Process Slurry Type Precipitation Water Softener and Coagulator.

REACTION TANK of Worthington Slurry Type Softener (Slurry bed eliminated for clarity). (A) Raw water influent line. (B) Vortexor for optimum slurry production. (C) Chemical Applicators. (D) Slurry bed rotator. (E) Symmetrical Slurry concentrator. (F) Proportionate sludge removal. (G) Collector trough for treated water. (G-1) Treated water effluent. (H) Complementary recirculation. (I) Filter wash water compartment. (I-1) Filter wash water suction. (I-2) Filter wash water return.

This slurry bed stays put!

. . . and troublesome variables are out

These Features Give You The Uniformity You Want

WORTHINGTON SLURRY TYPE PRECIPITATING WATER SOFTENER AND COAGULATOR gives consistent, uniformly softened water

If it's clear, uniformly softened water you want, this unique Worthington Water Softener is just what you need. Concentrated quick mixing and rapid recirculation of applied chemicals and raw water, *achieved by hydraulic energy instead of submerged mechanical moving parts*, is an important, progressive development in the water treatment field.

New Bulletin W-212-B5 gives you 16 pages of vital facts about this unique cold process water softening method. Write for your free copy today.

REMEMBER . . .

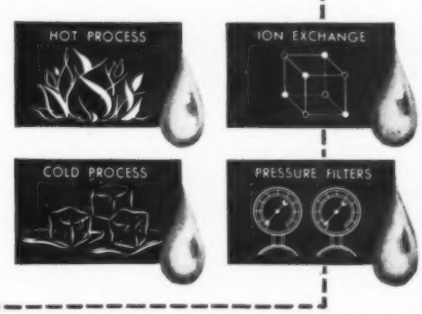
Worthington engineers *all four* water conditioning processes; therefore, can give you unbiased recommendations on which process is right for you . . . further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

JO.1

WORTHINGTON

WATER CONDITIONING

Worthington Makes More of the Equipment for All Types of Water Conditioning Systems



WITH NEW ILLUMINATOR ON YARWAY FLAT GLASS GAGE . . .

BOILER WATER LEVEL Shines li

It's light! It's bright! It's right! You see instantly the accurate boiler water level in your Yarway Flat Glass Gage because *the meniscus at water level stands out like a brilliant star* . . . thanks to the new Yarway Type "M" Illuminator.

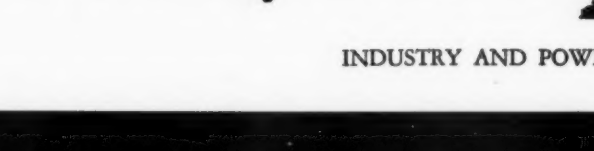
The Type "M" Illuminator is specially-designed to give maximum brilliance to Yarway flat glass inserts, and to spot the water level over its entire traverse. The superior penetration of its blue-white light cuts through extraneous light, dust particles in the air, and deposits on the gage glasses. Effective over longer distances.

New or already-installed Yarway Flat Glass Gages may be equipped with the Illuminator. Yarway Illuminators may be installed in pairs on four-glass gages.

Get in touch with your nearest Yarway office for further details on this latest Flat Glass Gage development, or write direct to . . .

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

A COMPLETE YARWAY WATER LEVEL SYSTEM



YARWAY

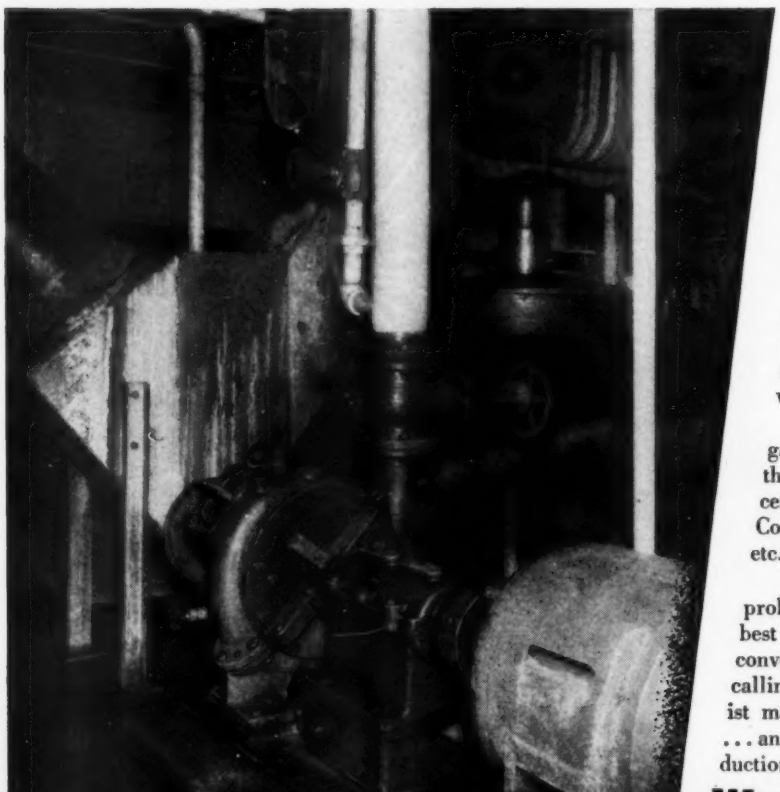
STEAM PL

es like a Star
TYPE "M" ILLUMINATOR ATTACHED
TO FLAT GLASS GAGE INSERT
YAR
WAY
AM PLANT EQUIPMENT

Hi Neighbor! Power Plant or Process—

There's a WARREN PUMP

engineered to your job!



For instance, Narragansett Brewing Company, New England's largest brewery, had a problem in the handling of spent grain which was solved by the installation of special Warren Pumps. These pumps were engineered and built for pumping pulpy materials of various densities and having properties which render them unsuitable for handling with most types of pumps.

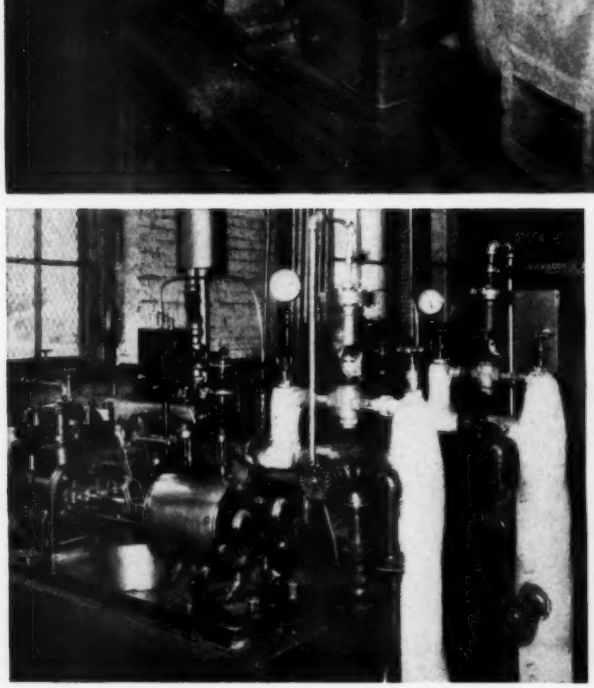
In the power plant at Narragansett, Warren Pumps are also on the job, including both steam and centrifugal and on Fuel Oil Service, Condensate, General Water Supply, etc., etc.

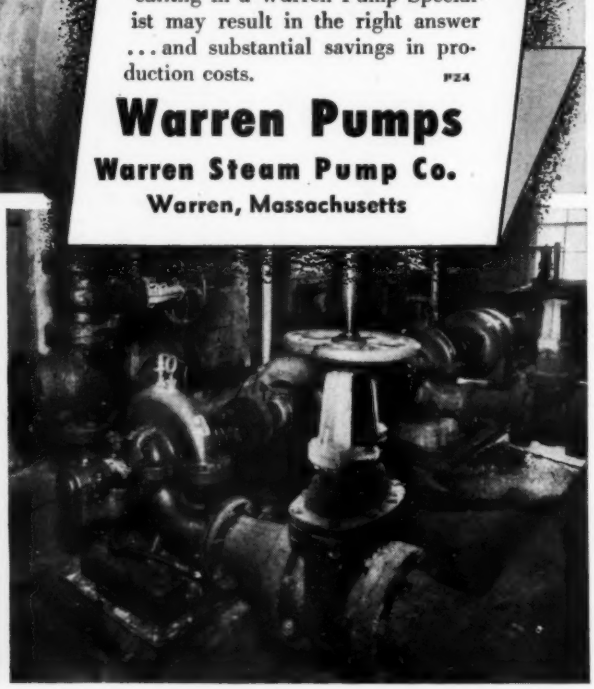
Perhaps you have a pumping problem, too . . . one that cannot be best solved by an "off-the-shelf", conventional type of pump. If so, calling in a Warren Pump Specialist may result in the right answer . . . and substantial savings in production costs. PZ4

Warren Pumps

Warren Steam Pump Co.

Warren, Massachusetts





THE I-D FAN STACK

with a Background

. . . YEARS OF EXPERIENCE
. . . THOUSANDS OF INSTALLATIONS

P-D Fan Stacks have proven themselves more efficient, economical and less expensive than conventional chimneys.

Prat-Daniel's background in both fan and stack design, covers the period of major development in modern power plant development. As the art progressed, improvements have kept P-D Fan Stacks ahead of draft requirements and today provide the ultimate in efficiency for your plant.

Write our project engineers for full details on improving the draft efficiency of your boilers.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

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T. C. Chown, Ltd., 1440 St. Catherine Street W., Montreal 25, Quebec

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PRAT-DANIEL CORPORATION

69-10 WATER STREET — EAST PORT CHESTER, CONN.

DESIGNERS AND MANUFACTURERS OF POWER PLANT EQUIPMENT FOR OVER 25 YEARS

NEED MORE "DRIVE" IN YOUR MACHINES?

Rex Light Chabelco . . . *for moderate loads*

Rex Universal Chabelco . . . *for heavy loads at higher speeds*

Rex 3100 Series Chabelco . . . *short pitch chain for high-speed service.*

Rex Heavy Chabelco . . . *for heavy loads*

If you want top performance from your machines . . . if you want drives that stand up under the toughest operating conditions, the Rex Chabelco Line of Chains and Sprockets is the answer.

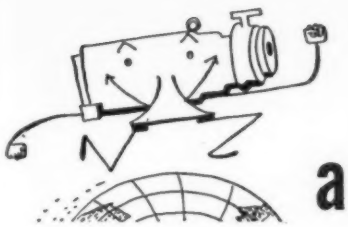
Specifically designed for drive service on equipment where steady, uninterrupted service is a "must," these husky steel chains *deliver more H.P. per dollar* . . . assure low initial and operating costs . . . and freedom from production loss due to premature drive failure. Often a Rex Chabelco Chain, single or double strand, will handle loads that would require triple or quadruple strands in other types of chain.

Where service is exceptionally severe . . . where equipment must operate under conditions of dirt, dust and temperature extremes, a Chabelco Chain will keep going when other driving mediums would soon fail. Designed-in clearances between working parts enable it to operate efficiently under these conditions and to accommodate minor misalignments.

Many sizes of standard Rex Chabelco Chains and Sprockets are now available from stock. For all the facts on how they can help you put more "drive" in your machines at the lowest over-all cost, call your Rex Field Office or write Chain Belt Company, 1650 West Bruce Street, Milwaukee 4, Wis.

CHAIN BELT REX COMPANY

DRIVE AND CONVEYOR CHAINS



Covers a Lot of Ground

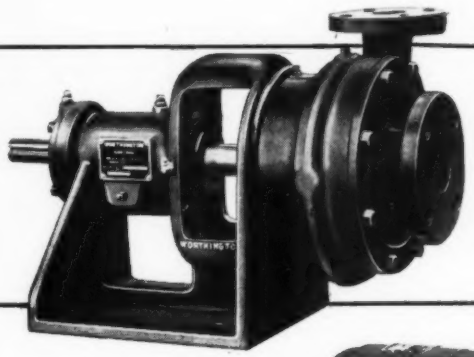
You can't find anything so certain to fit your exact requirements in a pump . . . as the Worthington standard centrifugal.

The types CN and DN really cover the waterfront—and all other "fronts." Capacities from 10 to 1800 gpm. Heads to 535 ft. 40 sizes of pump casings. 200 combinations of frame-mounted designs. Altogether, over 10,000 standard combinations to choose from.

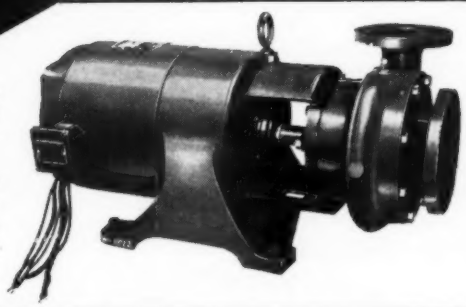
And still—there's maximum interchangeability of parts!

We have just your size

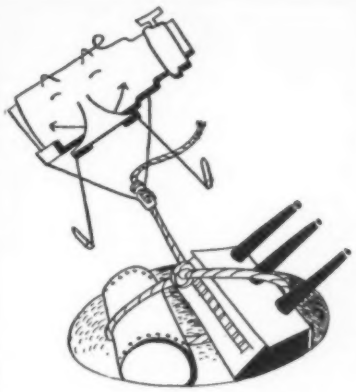
From this vast selection you're sure to find the one right pump for you. That means the end of compromising with pumps that are *not* just right—and the beginning of the money-saving performance proving *there's more worth in Worthington!*



Type CN, frame-mounted, is a real "any-drive" pump—readily driven by electric motor, V-belt, or any other mechanical power source.



Type DN is the famous Worthington Monobloc design—compact, streamlined, with built-in motor. On both types, liquid ends are interchangeable, and can be equipped with either conventional packing or mechanical seal.



Pump Pulls Boiler and Mill Out of Hole

A paper mill customer of Turner Supply Company, Mobile, Ala., having installed new equipment, couldn't operate it due to delay in delivery of a new boiler. While the existing boiler could be operated at the higher pressure required, the boiler feed pump in use was inadequate.

Turner Supply Company, a Worthington distributor, furnished from stock a pump which, when connected in series with the old pump, permitted the mill to operate the old boiler at a higher pressure. This arrangement was used for over three months, allowing the mill to make use of expensive new equipment before the new boiler was ready for service.

Remember—no distributor offers more pumps . . . no distributor offers more value in pumps . . . than a Worthington distributor.

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
PUMP AND COMPRESSOR MERCHANDISING DIVISION
Harrison, New Jersey

The Good Right Hand of Industry

POWER TRANSMISSION: sheaves, V-belts, variable speed drives.

PUMPS: centrifugal, power, rotary, steam.

AIR COMPRESSORS: water-cooled, air-cooled.

PC.0.7

Worthington Pump and Machinery Corp.
Pump and Compressor Merchandising Div.
Harrison, N. J.

Send latest bulletin on Worthington Centrifugal Pumps. Any other (type).....

Name.....

Company.....

Address.....

City.....State.....

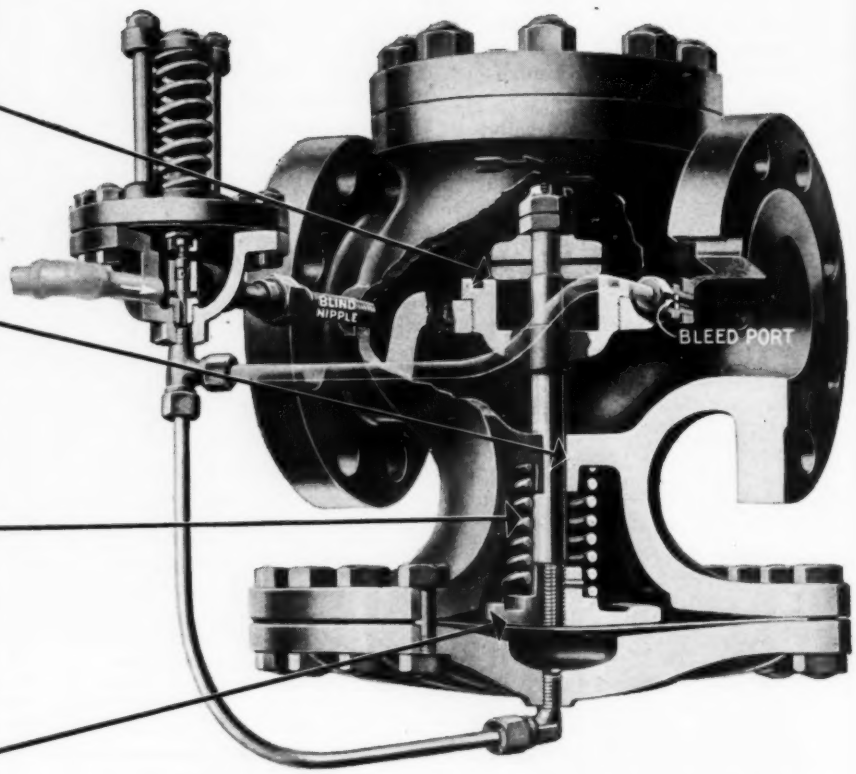
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator — operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

ACCURACY — You can be sure of accurate control for the life of the regulator.

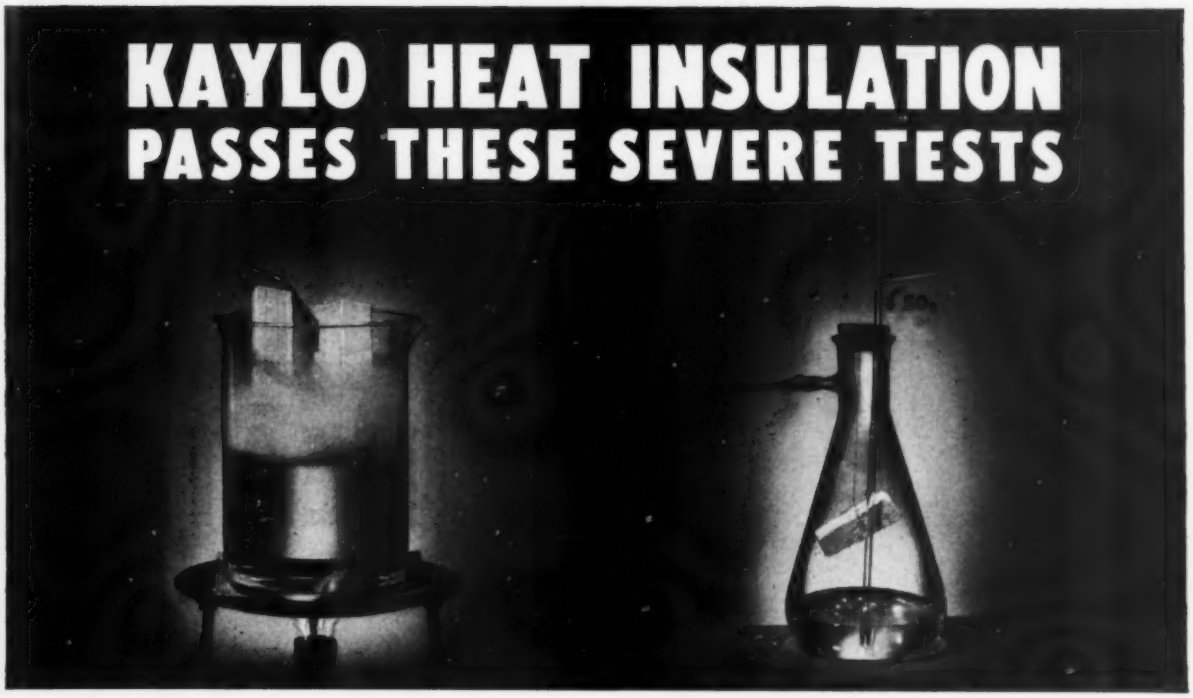
MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

SE-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

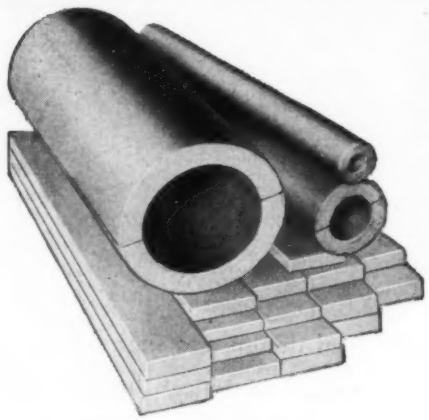
KAYLO HEAT INSULATION PASSES THESE SEVERE TESTS



BOILING TEST: Samples of Kaylo Heat Insulation have been boiled continuously for 24 hours and longer. None disintegrated or showed any loss of insulating efficiency after drying.

FUME TEST: Samples of Kaylo Heat Insulation were suspended in an aerated mixture of water vapor and SO_2. The Kaylo samples showed no deterioration after weeks of direct exposure.

One Material Insulates Efficiently up to 1200°F.



Kaylo Heat Insulation is made of hydrous calcium silicate (not glass), a remarkable material with high insulating efficiency up to 1200°F. This new type of inorganic insulating material retains its stability in long service under severe conditions. Exceptional strength and lighter weight make it easier to handle and apply.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for pipe sizes from ½" to 72". Coverings are sectional for sizes ½" to 12"; tri-segmental for 8" to 23"; quad-segmental for 19" to 41"; K-segmental (18" sections) for 38" to 72". O.D.'s of insulation correspond to O.D.'s of standard pipes.

KAYLO HEAT INSULATING BLOCK is available for single layer application in thicknesses from 1" to 6". It is made in all standard sizes up to 18" x 36".

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Kaylo Division • Toledo 1, Ohio

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Write for name of your local representative.

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BUFFALO 7, N. Y.

MILTON Roy

"Packaged" Systems

for BOILER WATER CHEMICAL TREATMENTS

The necessity is well recognized for feeding various chemicals to boilers for the prevention of scale and to control alkalinity, remove dissolved oxygen, protect against embrittlement and insure against corrosion and pitting caused by impurities in the boiler feed water. Practically all competent authorities agree that two distinct methods for conditioning boiler water are necessary.

First. sodium sulfite should be fed continuously to the suction side of the boiler feed pump to react with and remove any residual dissolved oxygen in the boiler feed water. This is necessary because oxygen in the water will act to corrode and pit the boiler feed water pump, economizers and boiler drums and tubes.

Second. other internal treating chemicals should be fed directly into the boiler drums to precipitate incrusting solids, to control alkalinity, and to give a chemical balance in the boiler to prevent corrosion and embrittlement.

Typical Milton Roy "Packaged" Systems for boiler water treatment are illustrated above. These systems are complete, include all necessary solution tanks, covers, gage glasses, low-level cutouts and alarms, motor starters and pumps as required. Automatic electronic controls can be supplied to operate pumps at speeds proportional to feed water flow as measured by flow meters. Systems are available to handle all treating chemicals and to meet all capacity and pressure requirements.

For complete information, ask for Bulletin 4811 and Technical Paper No. 51 "What the Power Engineer Needs to Know about Chemical Feed Systems."

MILTON Roy COMPANY

WITH THE EXCLUSIVE STEP-VALVE DESIGN

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Settling basins, enclosed by earth dykes, operate in rotation according to plant needs so each one can be dried, plowed and harrowed before being filled. Breaking up the surface keeps the bed porous so water seeps into ground

Replaces Ground Water Through Series of Plant-Effluent Settling Basins

Water supplies no longer can be considered unlimited. If your water comes from underground, here is a way to conserve the supply instead of discharging plant effluent to waste in a nearby stream. It may also fit into plans for laying out a stream anti-pollution program

FOUNDED in 1915, by R. A. Weber and F. C. Wettlaufer, the Independent Textile Dyeing Co. Inc., Farmingdale, N. Y. now processes 1,000,000 yards of nylon and rayon cloth a week for manufacturers and jobbers. Cloth comes to the plant in the gray state for scouring, bleaching, washing and dyeing. Final operation is rinsing and finishing before the finished product is shipped to its final destination.

Complete processing requires 15,000,000 gal of water a month all of which comes from four wells, one 500 ft, another 90 ft and two 35 ft deep.

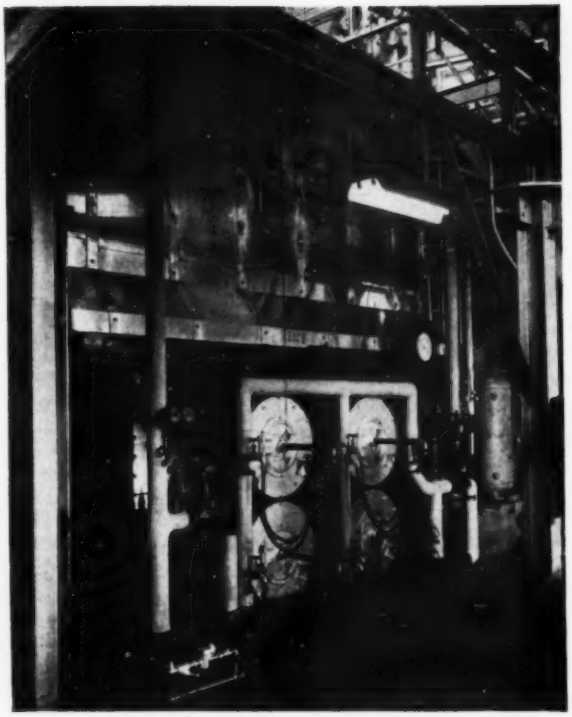
Located on Long Island, where communities depend on wells for their water supply, waste effluent from the plant goes to large catch basins excavated on a 20-acre tract of land adjoining the plant. These are filled, one at a time, and allowed to stand until the water seeps into the ground. After each basin dries, the soil is plowed and harrowed before next filling. This hastens seepage and prevents the water becoming stagnant and giving off unpleasant odors.

Running too close to full steam capacity in a dyeing plant may mean a spoiled batch of goods if unexpected boiler trouble occurs and the unit has to be shut down. Management met this situation by installing a 200-psi, 55,000 lb per hr boiler capable of producing 65,000 lb per hr for two-hour periods.

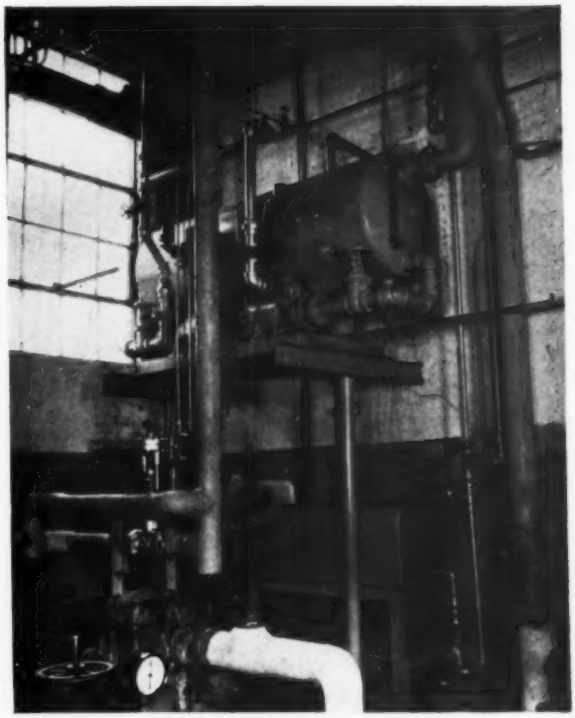
A forced draft fan, located behind the boiler, forces combustion air through ducts beneath the furnace floor to the wind box encasing the oil burners. This method of air delivery preheats the combustion air and cools the furnace floor.

The unit with its steam flow—air flow ratio combustion control and feedwater regulator meets load swings of 20,000 to 60,000 lb per hr on plant startup and when additional dyeing machines go into operation. One old boiler was scrapped to make room for the new unit and spare capacity now consists of water tube boilers, one 6,000 sq ft and the other 1,500 sq ft, both of which are being equipped with fully automatic combustion control.

Most of the steam (85%) goes directly to process, remaining 15% is used for building heating and boiler-room auxiliaries. Exhaust steam from the turbine driven forced-draft fan heats the process water to 140 F which, for some uses, is raised to 180 F.



Oil-fired, 55,000-lb-per-hr boiler, fitted with combustion and water-level controls, takes swings of 40,000 lb per hr



Condensate from the plant heating system returns to overhead pump unit, which sends it to the deaerating heater

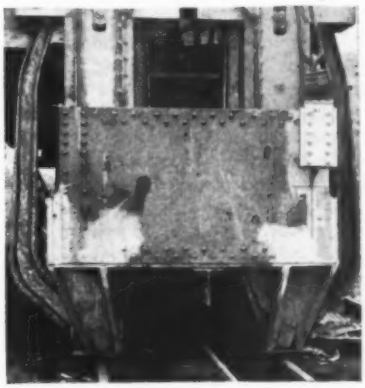
PRINCIPAL EQUIPMENT IN THE INDEPENDENT TEXTILE DYEING CO. INC., PLANT

Boiler	The Babcock & Wilcox Co.
55,000 lb per hr, capable of 65,000 lb per hr, 200 psi saturated, integral furnace, air-cooled floor, water walls and cyclone separator, aluminum casing	
Casing	The National Boiler Casing Co.
Soot Blowers	Diamond Power Specialty Corp.
Combustion Control	Bailey Meter Co.
Feedwater Regulator	Northern Equipment Co.
Feedwater Treatment	The Permutit Co.
Proportioning Pump	Milton Roy Co.
Strainers	Leslie Co.
Continuous Blowdown	Strong, Carlisle & Hammond Co.
Deaerating Heater	The Permutit Co.
Float Valves	Kieley & Mueller, Inc.
Pressure Control	Leslie Co.
Temperature Recorder	Moeller Instrument Co. Inc.
Forced-Draft Fan	L. J. Wing Mfg. Co.
Stack	Thermix Engineering Co.
Induced-Draft Fan	Thermix Engineering Co.
Motor	General Electric Co.
Turbine	Carling Turbine Blower Co.
Starter	Allen-Bradley Co.
Water Column	Reliance Gauge Column Co.
Boiler Feed Pump	Warren Steam Pump Co. Inc.
Turbine Drive	Carling Turbine Blower Co.
Oil Burners	Coen Burner Sales Co.
Electric Heaters	Preferred Utilities Mfg. Corp.
Tank Gages	Uehling Instrument Co.
Steam Heaters	Coen Co.
Pumps	Northern Pump Co.
Pressure Gages	Manning, Maxwell & Moore, Inc.
Condensate Return System	John Feklinger Co.
Thermometer	Taylor Instrument Cos.
Valves	
Non-return	Walworth Co.
Safety	Manning, Maxwell & Moore, Inc.
Blowoff	The Babcock & Wilcox Co.
Boiler Feed	Crane Co.
	Fairbanks Co.
	Jenkins Bros.
Air Compressors	Westinghouse Air Brake Co.
	Worthington Pump & Machinery Corp.
Pressure Reducers	A. W. Cash Co.
Filters	Bailey Meter Co.
Contractor	A. Wilson & Co., New York, N. Y.

Rail Clamps Hold Crane Against High Winds

● Pressure supplied by powerful helical springs through a toggle system and lever arms, applies clamps to each side of the rail to hold the crane against wind velocities up to 106 mpr. A 7½-hp motor on each leg drives a winch drum through worm reducer and spur gear to operate the clamps for that leg. When the wind velocity approaches a predetermined limit an anemometer generator automatically releases the holding motor and the clamps grip the rails.

The clamps in the photo are installed on two 1,800-ft outdoor runway cranes, that handle ore for the Crucible Steel Company of America. Each clamp squeezes the rail with a pressure of more than 192 tons, giving the crane a gripping force of about 768 tons. Clamp springs are made of 1¾-in. steel wire. To release the clamps, the coiled springs are compressed and the toggle is pulled closed through a wire rope sheave operated by the winch. *Dravo Corporation*



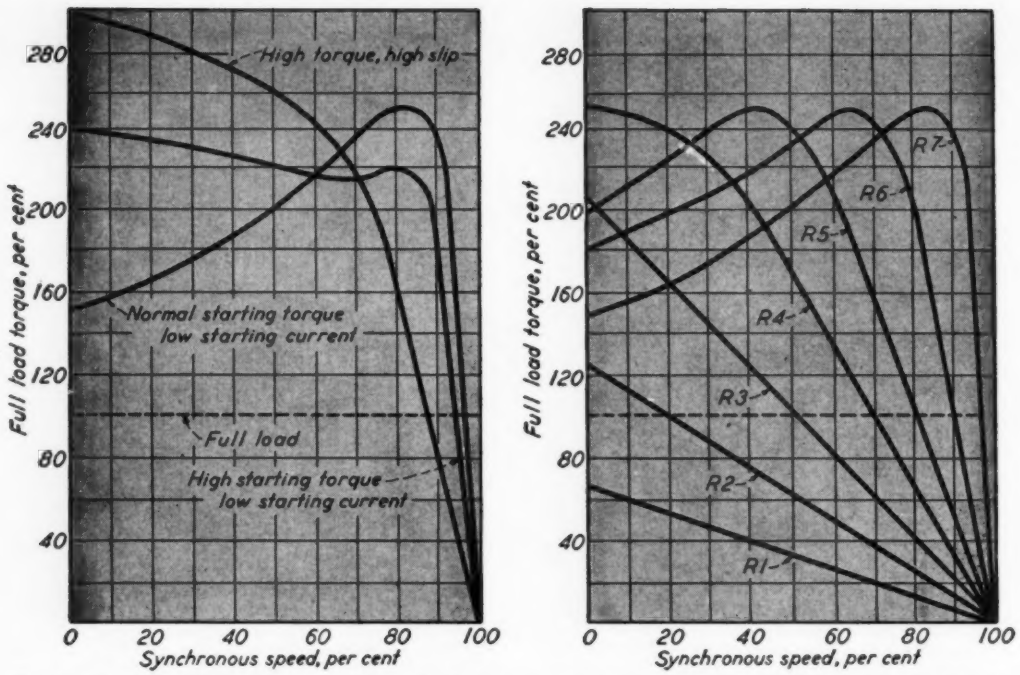


Fig. 1—(Left) Speed-torque curves for squirrel cage motors are compared to load for adequate starting torque, load speed and power. Fig. 2—(Right) Wound rotor motor characteristics vary with rotor resistance

FITTING A MOTOR TO ITS LOAD

Get maximum efficiency from a-c motors by considering all of the factors necessary to match them to the application. This step-by-step discussion of the important specifications greatly simplifies the task of selection

H. CARL BAUMAN, *Chief Engineer,*
Electrical Division, American Cyanamid Company

BEST SERVICE and optimum economy require that a motor be properly specified for the particular duty it is to perform. Seventeen factors required for a thorough job of selecting the right a-c motor are, in order of relative importance: (1) horsepower, (2) volts, (3) phases, (4) frequency, (5) speed, (6) torque, (7) type of bearings, (8) enclosure, (9) ambient temperature, (10) winding insulation, (11) horizontal or vertical mounting, (12) method of coupling, (13) operating cycle, (14) altitude, (15) balance, (16) end play, (17) thrust.

Before specifying the horsepower, the load must be rather accurately determined. Usually the machine manufacturers will specify motor horsepower required for their equipment. If not, a prony brake test, details of which may be found in most handbooks, may be made for torque as well as horsepower.

$$\text{Prony brake hp} = \frac{2\pi N\,(Fr)}{33{,}000}$$

Where:
hp = horsepower
N = rpm
F = balancing weight in lb
r = lever arm for F
Fr = motor torque

Another method is to drive the machine whose horsepower is desired with a motor for which efficiency and power factor curves are available. From readings obtained with a voltmeter and ammeter, 3-phase horsepower is:

$$hp = 0.00232\ EI \times pf \times eff$$

Where:
E = motor volts
I = phase amps
eff = efficiency from curves
pf = power factor from curves

Many loads are cyclic or intermittent, as with a punch press. The power may have one value for a given time, another level for another time, and so on until a cycle is completed and the pattern begins to repeat itself. In such cases, rms or effective horsepower must be found by multiplying the square of the horsepower for each period by the time, adding all the products for a complete period, dividing by the total time of the cycle (including $\frac{1}{3}$ the off time for open and $\frac{1}{2}$ the off time for enclosed motors) and finally extracting the square root. The formula is:

$$(hp_e)^2 = \frac{A^2t_a + B^2t_b + \cdots}{\frac{1}{2}t + t_a + t_b + \cdots}$$

Where:
hp_e = rms hp
t = off time during cycle
A = hp during time t_a
B = hp during time t_b

and so on for any number of periods in a complete cycle as shown by dots.

For economy, the motor selected should have a standard rating as close to the required horsepower as possible. For example, if the calculated horsepower by this method is eleven a 10 hp open motor should be selected since it is within the 15% service factor allowed for an open motor.

The voltage specified should be that of the available source, although there are normal limitations. It is becoming common practice to specify motors up to approximately 125 hp at voltages up to 440. For larger motors, 2300 and 4160 v are quite common. At approximately 125 hp, cost of low voltage switching equipment added to the cost of the motor starter and larger copper for wiring exceeds the combined cost of motor, gear and wiring at higher voltages.

In most power systems, it is best for economic reasons to balance all phases on the electrical system. Large industrial users of motors specify motors ⅓ hp and larger for 3 phase. Motors of ¼ hp or less are generally specified for single phase.

Frequency of motors is that of the system upon which they will operate. In the United States this is largely 60 c, although 25 and 50 c areas are still quite prevalent.

Speed of the motor must match that of the driven machine. A-c motors operate at speeds approximately 2 to 4% less than their synchronous speeds. Synchronous speed of the motor is determined from the expression:

$$N = \frac{120\,f}{P}$$

Where:
N = synchronous speed in rpm
f = frequency
P = number of poles

Synchronous motors run at speeds determined from the above formula. High slip motors operate at speeds approximately 13% less. Wound rotor induction motors can be varied from 50% to 100% of synchronous speed by means of secondary resistors.

With this general range, a motor can be selected with a speed equal to that required by the driven machine. There are, of course, some economic considerations. For instance, if the machine speed is 450 rpm, it may be best to consider a 900 or 1200 rpm motor and driving the machine through belts or chains. Generally, the motor cost increases as speed decreases.

The motor selected must have sufficient turning power to bring the machine up to speed and maintain its speed at its rated load. This means enough torque to overcome inertia of the machine at standstill and to bring it up to full speed in a short enough time to prevent overheating of motor windings by high starting currents.

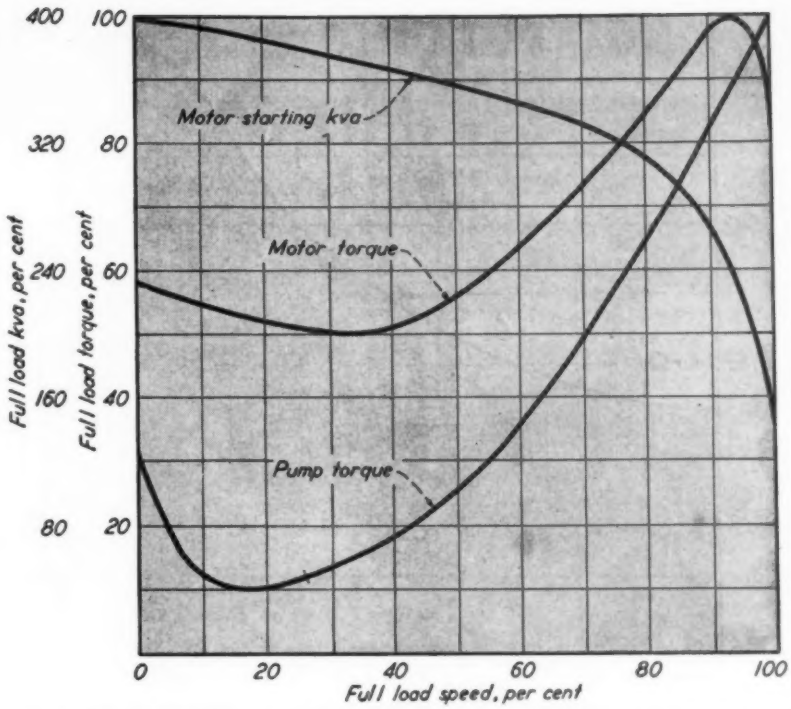


Fig. 3—Speed is increased by motor torque available in excess of torque required by driven machine. Machine runs at speed where the motor and machine curves cross

Typical torque-speed curves are shown in Figs. 1 & 2 for squirrel cage and wound rotor motors, respectively. The time for acceleration from standstill to rated speed is calculated as follows:

$$t = \frac{N\,(mr^2)}{308T}\ \text{sec}$$

Where:
mr^2 = inertia of moving parts in lb-ft²
T = average motor torque in lb-ft
N = motor speed in rpm

To accelerate the load, motor torque must lie at all times above the torque curve of the driven machine, Fig. 3.

Torque varies inversely as the speed and, at the output shaft of an increaser, will be less than motor torque. If a reducer is used, the torque will be greater. It is related to horsepower by the expression:

$$hp = \frac{NT}{5250}$$

Where:
N = machine speed in rpm
T = machine torque

Torque varies as the square of the voltage at motor terminals. Reduced voltages required by power company ruling in starting a large motor must be considered. For instance, at 70% of rated voltage, torque becomes 49% of rated full load value, Fig. 4. Motor torque always should be higher than that of the machine. Otherwise the motor will cease accelerating and hang at low speed until voltage is increased.

Squirrel cage induction motors are available in several classifications: (a) normal starting torque—low starting current, (b) high starting torque—low starting current, and (c) high starting torque — high slip. Starting torque characteristics are obtained by proper design of rotor lamination punching.

An open type motor is most economical in clean relatively dry atmospheres. It is less expensive than motors with other enclosures and has a service factor of 15% when ambients do not exceed 40 C. This means that the motor may be overloaded 15% without exceeding the manufacturer's temperature rise limitations of 95 C total for this type of motor.

In a moist atmosphere where water may drip from above, a drip-proof motor is specified. Most manufacturers now supply this style at the same price as the open motor. Its service factor is identical.

Totally enclosed motors are used for outdoor installation, in most chemical plants or in dirty non-hazardous areas. These motors are rated 55 C rise, continuous operation, and cannot be loaded beyond their nameplate reading. It is becoming customary to provide the housings with plugs for draining condensed moisture from the interior.

Totally enclosed, fan-cooled explosion-proof motors are specified in several classifications for hazardous areas. The most frequently used are those in Class I, Group D made to operate in atmospheres containing gasoline, petro-

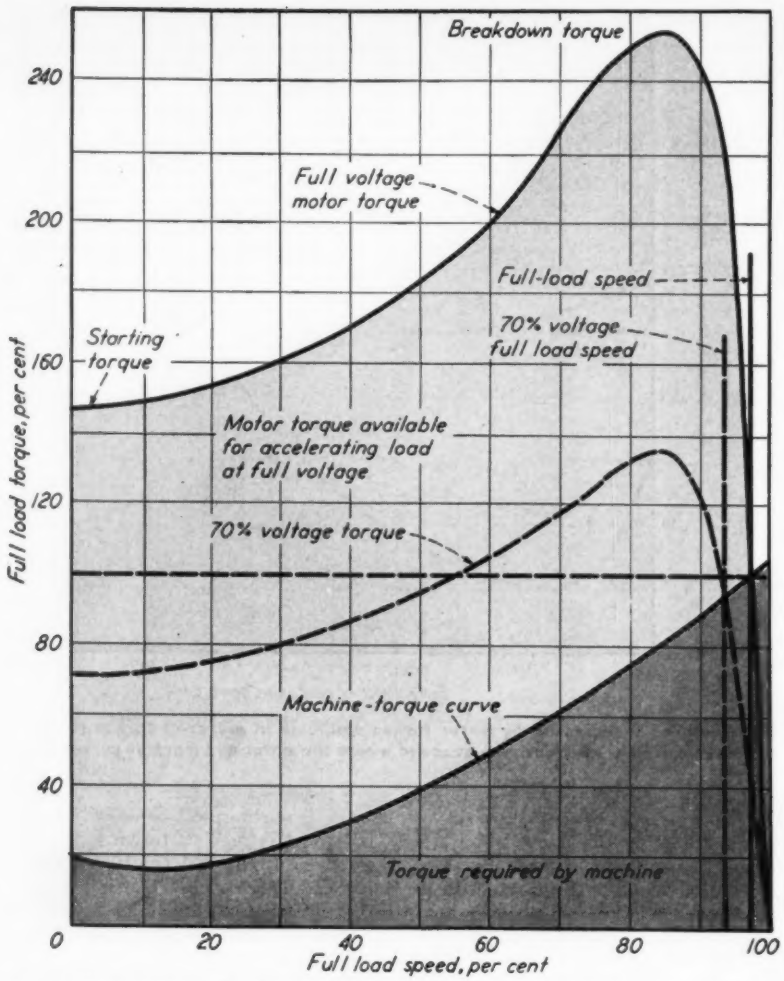


Fig. 4—Motor torque at reduced starting voltages must lie above machine curve to bring machine to running speed and prevent motor burnout by high starting current

leum, naphtha, acetone, lacquer solvent vapors and natural gas. Motors in Class II, Group G are designed for atmospheres containing grain dust.

A splash-proof motor is recommended for installation in areas subject to hosing, and in certain outdoor locations. This motor has a guaranteed temperature rise of 50 C above an ambient of 40 C and will take a small overload of approximately 5% without exceeding the manufacturer's guaranteed limitations.

Motors are rated on a heat basis. They may operate over nameplate rating when ambient is less than 40 C, provided total temperature limits are not exceeded.

Unless otherwise specified, motors are provided with organic type insulations, standardized as Class A types. These include such insulation as cotton, silk and resins. Class B insulation consists of inorganic types such as glass, mica and asbestos.

Anti-friction ball or roller bearings are most frequently used in modern motors. Sleeve bearings are available for larger machines in the high speed categories. Most motors are purchased for horizontal operation. However, when necessary to operate them vertically, this must be specified so that proper bearings may be provided to take thrust.

Motors to be installed in altitudes more than 3,300 ft above sea level must be derated. The rarefied air causes the temperature of the motor to rise about 1% for each 330 ft increase above 3,300 ft.

In certain applications such as high speed grinders or spray machines, balance of the motor becomes important and there will be limits of vibration which should be specified for such machines. For precision work, normal end play may have to be limited to small values. This factor, of course, will increase the cost of the motor.

Largest Atomic Furnace Fired-up at Brookhaven National Laboratory

● Chain reactions were recently started in the nation's largest and most powerful research reactor at Brookhaven National Laboratory at Upton, N. Y. Heat at a rate equivalent to 30,000 kw, several times that of the Oak Ridge reactor, will be developed in the two-story graphite cube which contains the uranium fuel. Several feet of protecting concrete surround the graphite to bring the outside dimensions of the furnace to 38 ft.

Small slugs of pure natural uranium, several tons in all, are encased in aluminum cartridges and located through channels in the graphite cube in a carefully defined pattern. One in every 140 uranium atoms is a U235 atom which will split, or fission, when hit by a neutron, release more neutrons to strike other atoms and so on. However, the neutrons must be slowed down to be effective, and the uranium slugs must be so located that the neutrons from a disintegrating atom will strike enough other U235 atoms to produce an increased number of neutrons. Under these conditions the reaction will be self sustaining.

Graphite is a moderator which slows the neutrons, and by doing so, absorbs their energy in the form of heat which may be used by industry to generate steam and electricity. At present, heat must be carried away by 300,000 cfm of air to prevent overheating of this research furnace.

The graphite cube also serves to locate the uranium slugs so that the proper percentage of neutrons will hit other uranium atoms at the proper speed. Boron absorbs neutrons, and rods of the metal are inserted to control reaction rate. Channels in the graphite are provided so that materials may be inserted and exposed to the excess neutrons or so that neutron "beams" may be studied outside the furnace.

Research of direct industrial significance includes studies on effects of radiation on materials, use of activated materials as tracers as for studying oil films, and internal structure of materials. Some information will be obtained on the use of atomic energy for power although this type of research is centered at other reactors.

A preview of atomic furnace maintenance problems includes the removal of the decomposition products of uranium and activated structural materials which may interfere with the reaction, and the disposal of activated waste.

THEORY, DESIGN AND APPLICATION OF PNEUMATIC CONVEYING SYSTEMS

In the second part of this article on pneumatic conveyers, the author outlines the procedure for determining pipe and nozzle velocity, horsepower loss in pipe and nozzle, and horsepower required to operate the system. A typical design problem is solved to demonstrate formulas

WILBUR G. HUDSON, *Consulting Engineer*

LOW PRESSURE large air volume installations handling a variety of materials can be accomplished in numerous ways, and this concluding part of the article will deal with design analysis based on actual test data from the field. Original design and installation procedures were found to be accurate within practical limits.

A typical car-unloading installation, Fig. 1, is to handle 40 tph of flaxseed weighing 45 lb per cu ft in bulk, specific weight (wt in the solid), 82 lb. The best application is to employ a flexible hose and nozzle, a centrifugal separator and tandem centrifugal dust collector to protect the exhauster. However, any combination of separator and stocking type dust collector could be selected with little change in results as regards power requirement.

Air Volume Formula

After a series of tests on numerous layouts that handled various capacities and materials, the following formula was determined:

$$Q = WT$$

Where:
Q, is cfm of free air
W, specific wt, lb per cu ft
T, tons handled per hr.

Substituting the values from the problem gives; $Q = 82 \times 40 = 3280$ cfm. Air-stream velocity is determined next and pipe diameter is selected to suit. The velocities required for various weights of material were determined through actual trials and these formulas are found in Table 1.

Air blast for balancing must correspond to the particle weight, and velocity must be increased to move the material at, say, 50 fps. Nozzle orifice efficiency usually is taken as 60%. As the hose is of smaller diameter than the duct these velocities must be higher.

Knowing the loss in pressure due to air friction in pipes of different diameters is necessary. These values can be determined from tests developed by Unwin. The values in Table 2 are pressure losses (p) in oz per sq in., for $V = 100$ fps, and $L = 100$ ft.

Pressure loss in the duct, P, is found with the following formula:

$$P = p \left[\frac{V}{100}\right]^2 \frac{L}{100}$$

Where:
V, is duct velocity
L, is duct length

Pressure loss varies as the square of the air stream velocity, indicating the importance of using the minimum conditions that will do the job.

Velocity-pressure for orifice efficiency can be found with the formula:

$$\frac{V^2}{10000} \times e$$

The factor (e) for intake orifice efficiencies varies from 1.32 at 100% to 3.00 at 80% and 8.00 at 50%. Horsepower to handle Q, cfm of free air at P, psi is:

$$HP = \frac{Q \times P}{230} \text{ (approximate)}$$

with an assumed exhauster or blower mechanical efficiency of 87½%, the

$$\text{Initial HP} = \frac{Q \times P}{200}$$

Q must be increased to allow for air slip in the blower, and this varies as P^2. To determine motor horsepower the average slip is taken as 14%, or a "pneumatic efficiency" of 87.5%.

In the pressure system the following formulas are employed:

$$\text{Motor HP} = \frac{Q \times P}{175}$$

In the suction system,

$$\text{Motor HP} = \frac{Q \times P}{175} \times \frac{14.7 + P}{14.7}$$

By transposing "Initial HP" formula and solving for P, the total pressure required in the system is:

$$P = \frac{HP \times 200}{Q} \text{ (psi)}$$

$$P = \frac{HP \times 3200}{Q} \text{ (oz per sq in.)}$$

The latter equation is a convenient form for calculating pneumatic systems. In addition to the air pressure losses there are the material pressure losses. Velocity of the material is assumed to be 80% of the air stream velocity. This velocity is attained from rest in one second by the pick up velocity of the air in the nozzle.

Formula nomenclature contained in Table 3 gives a step-by-step procedure to obtain the horsepower requirements of a pneumatic conveying system.

Proceeding with the determinations for the layout in Fig. 8, the estimated Q is 3280 cfm. Line velocity, Table

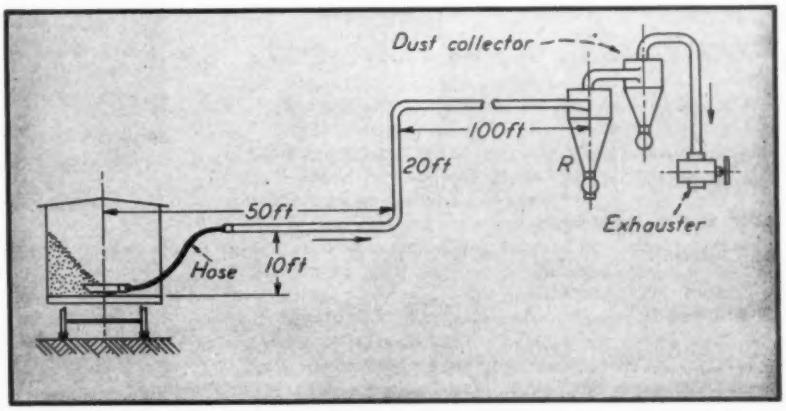


Fig. 1—Positive type blower, in this system, has a constant volume-varying pressure characteristic adjusting suction pressure to flow conditions at the nozzle

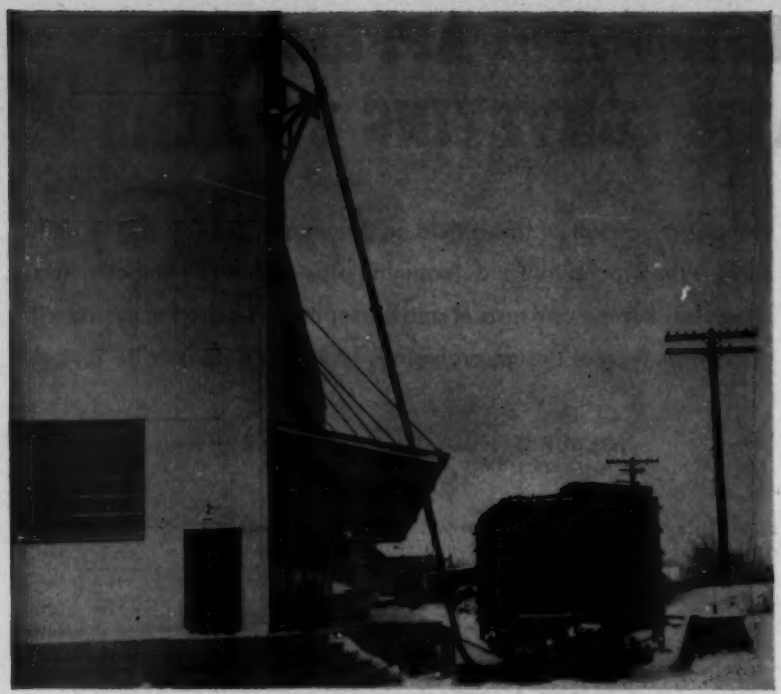


Fig. 2—This high-pressure pneumatic conveyer system removes bulk material from a freight car through a small diameter pipe and distributes it to a storage bin

1, is $1.06 \times 15\sqrt{82}$ or 146 fpm. A 9 in. line at 140 fps gives 3700 cfm and a 7 in. hose at 230 fps gives the same volume (Unwin). Therefore, Q — 3700, V — 146, V_h = 230. The air horsepower losses are tabulated in Table 4, while the material pressure losses in terms of horsepower are indicated in Table 5.

When this procedure is worked through for a heavier material, such as rock salt (Sp wt 136 lb) carried in an 11 in. line with 5950 cfm, the horsepower necessary is 187. With an extremely light material, such as ground cork (Sp wt 37.5 lb) with an 8 in. line and 1600 cfm, the horsepower would be 62. The efficiency of a pneumatic conveyer goes down as the lumps or particles become larger and as the specific weight goes up.

Air Requirement

Of particular interest is the comparison of material volume and volume of the air required to convey it. This is called "saturation". From the basic formula,

$$Q = WT$$

is in terms of air per minute. However, in terms of air per hour the equation would be:

$$Q' = 60WT$$

Volume of material handled is:

$$X = \frac{T \times 2000}{W} \text{ (cu ft per hr)}$$

thus;

$$\frac{Q'}{X} = 60\,WT \div \frac{T \times 2000}{W} = \frac{3\,W^2}{100}$$

is the ratio of the air volume to the material volume in the solid. When the weight of material in bulk is W_b, the ratio of air volume to material volume in bulk is:

$$\frac{3\,W^2}{100} \times \frac{W_b}{W} = \frac{3\,W \times W_b}{100}$$

To illustrate, the weight of bulk flaxseed (W_b) is 45 lb, and solid it is 82 lb. The ratio of air volume to material volume in the solid is:

$$\frac{Q'}{X} = \frac{3 \times 82^2}{100} = 200 : 1$$

The ratio of air volume to material volume in bulk is:

$$\frac{3 \times 82 \times 45}{100} = 110 : 1$$

Saturation, of course, differs widely as the weight of material changes. For rock salt the respective ratios are 555

TABLE 1—VELOCITY REQUIREMENTS

	Balancing velocity	Line velocity*	Hose velocity*
STRAIGHT HORIZONTAL DUCTS			
Dusty materials	$5\sqrt{\frac{w}{c}}$	$10\sqrt{w}$	$16\sqrt{w}$
Grains	$6\sqrt{\frac{w}{c}}$	$12\sqrt{w}$	$20\sqrt{w}$
Gritty and uneven	$7\frac{1}{2}\sqrt{\frac{w}{c}}$	$15\sqrt{w}$	$24\sqrt{w}$
DUCTS WITH ELLS AND RISERS			
Dusty materials	$10\sqrt{\frac{w}{c}}$	$12\frac{1}{2}\sqrt{w}$	$20\sqrt{w}$
Grains	$12\sqrt{\frac{w}{c}}$	$15\sqrt{w}$	$24\sqrt{w}$
Gritty and uneven	$15\sqrt{\frac{w}{c}}$	$18.75\sqrt{w}$	$30\sqrt{w}$

*plus or minus 6 per cent

TABLE 2—FORMULAS AND NOMENCLATURE

V_1, nozzle speed (V is pipe velocity) is	1.60 V
material speed leaving hose is	$0.5V_1 = 0.80V$
f, hp loss due to inertia is	$TV \div 100{,}000$
g, hp loss in hose assumed as ½ of f	
h, hp loss in conveyer line is	$\frac{T}{1000}\left(H + \frac{L}{5}\right)$
k, hp loss at each 90 deg elbow is	½ of f
m, total initial hp required for material is	f + g + h + k
M, convert initial hp into pressure	$\frac{M \times 3200}{Q}$ oz per sq in.
n, total loss (air hp plus material hp losses)	(A + M) oz per sq in.
P, is	$\frac{A + M}{16}$ psi
For pressure systems	$hp = \frac{Q\,P}{175}$
For suction systems	$hp = \frac{Q\,P}{175} \times \frac{14.7 + P}{14.7}$

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TABLE 3—PRESSURE LOSSES

Diameter, d.	p	Q
5	4.25	820
6	4.88	1170
7	3.95	1600
8	3.25	2090
9	2.77	2660
10	2.43	3270
11	2.14	3960
12	1.93	4710

TABLE 4—TABULATED AIR HORSEPOWER LOSSES

a, pressure loss at orifice, (63% efficiency assumed), $\left[\frac{V^2}{10{,}000}\right] \times 5$	= 26 oz per sq in.
b, pressure loss in hose (Unwin) $\left[\frac{230}{100}\right]^2 \times \frac{35}{100} \times 3.95$ (Hose length 35 ft)	= 7 oz per sq in.
c, pressure loss in 9 in. line (Unwin) $\left[\frac{140}{100}\right]^2 \times \frac{190}{100} \times 2.77$ (Line 190 ft)	= 11 oz per sq in.
d, pressure loss in receiver and dust collector (assumed)	= 8 oz per sq in.

TABLE 5—TABULATED COMPUTATIONS FOR HORSEPOWER

f, inertia loss	$40 \times \frac{140^2}{100{,}000}$	= 8 hp
g, loss in hose	50% x f	= 4 hp
h, loss in line	$\frac{40}{1900}\left[30 + \frac{200}{5}\right]$	= 3 hp
k, loss in three elbows	f/2 x 3 approximate	= 12 hp
m, total hp loss	f + g + h + k	= 27 hp
M, convert initial hp into pressure	$\frac{27 \times 3200}{3700}$	= 23 oz
P, total pressure loss in psi	$\frac{55 + 23}{16}$	= 5 psi
hp,	$\frac{3700 \times 5}{175} \times \left[\frac{14.7 + 5}{14.7}\right]$	= 142 hp

and 326, and for ground cork they are 17 and 5.6.

Dust collectors should be located between receiver and exhauster for maximum protection of the exhauster. The stocking type combination receiver and filter is more efficient than the centrifugal dust collector and is preferred.

Performance of a high-velocity air stream is less predictable than the action of any other conveying medium. Some materials are unexpectedly abrasive, for example the shell of flaxseed has a cutting action almost like that of a sand blast. Materials of this nature rapidly cut the outer face of elbows and receiver shells. Oats are easy to handle, but the eddies damage the sheath of the grain seriously. Fuzzy cotton seed locks into a mass and will not feed into the usual nozzle. Copra handles nicely but the oil tends to exude in the receiver and builds up a heavy lining. There is no difficulty with sulfur, but friction may build up a static charge and produce a dust explosion hazard. However, frequently the pneumatic conveyer is easily the best solution to a material handling problem.

Stud-Welding Cuts Construction Costs

COST of erecting two huge 20-sided sludge dryers now being completed at Jones Island (Milwaukee) for the Milwaukee Sewerage Commission has been substantially reduced through the use of stud welding in the erection of asbestos cement lining and exterior walls and Rockwool insulation.

More than 25,000 (¼ x ⅜ in.) cadmium-plated Nelson studs were utilized in the installation of ½ in. thick flat Transite enclosing the dryers. Another 5,000 (¼ x 2-¾ in.) cadmium-plated slug-loaded studs were employed to install corrugated asbestos enclosing other parts of the unit. Each of the dryers is 35 ft in dia and 80 ft high and they are connected by covered passages.

All of the flat and corrugated material was pre-drilled on the ground to expedite erection. Two complete layers of Transite were installed—one on the inside and the other on the outside of 4 in. Zerolite insulation. This method of stud welding proved to be the most economical way of meeting the erection problem.

Rockwool insulating material, on the bottom of the dryers, was placed with the aid of 10 gage insulating pins installed on the floor with the Nelson stud welding gun. The material was impaled over the pins and clipped. *Courtesy of Nelson Stud Welding Div., Morton Gregory Corp.*

Monitoring Systems That Gather

PROCESS VARIABLES AT YOUR DESK

These selector networks bring data from 1000 widespread measuring points to your fingertips for a constant check on the efficiency of today's huge process units.* Modified circuits record data, start and stop pumps or make many remote control settings from central points

E. P. GRACE, Jr., *Instrument Consultant*
Sun Oil Company

INCREASE in size of process units, and the ever mounting dependence on instrumentation to correlate all functions of these huge installations, have posed many problems for the instrument engineer in recent years. One of the most exasperating of these has been the matter of measuring at a central point the miscellaneous temperatures, pressures, levels, and flows. These are not critical in the operation but are of great importance to the operator or engineer in determining the optimum operating condition of various pieces of equipment such as heat exchangers, pumps, and compressors.

General practice in the past has been to convert the various physical measurements involved to electrical units and run wires to a central point where a multitude of key switches was made available for the operator to select any particular point for measurement. The problem of wiring and switch arrangement was difficult—to say nothing of spares and future additions. Faced with a requirement for between 500 and 1000 indicated temperature points and a limited panel space, an investigation of circuits and equipment similar to that used in telephone work was instigated.

An analysis of many process units indicated that the best system would be a switching unit accommodating 10 points installed near the points of measurement with short leads to the measuring devices. A common two-wire bus can connect all the switching units and the indicating instrument.

The first complete system was designed and built by the Sun Oil Company and accommodated 400 indicating temperature points. All subsequent systems have been built by the Panellit Company.

Various systems described in this paper each contain 3 separate circuits; the selecting circuit which operates at 45 v d-c, the measuring or controlling circuit and the checking circuit.

Stepping switches are all similar and have been identified by their position in the digital system. They are referred to as hundreds, tens and unit switches. The measuring device is connected only to the unit switches.

*Abstracted from a paper presented at annual meeting of ISA at Buffalo, N. Y., Sept. 19, 1950.

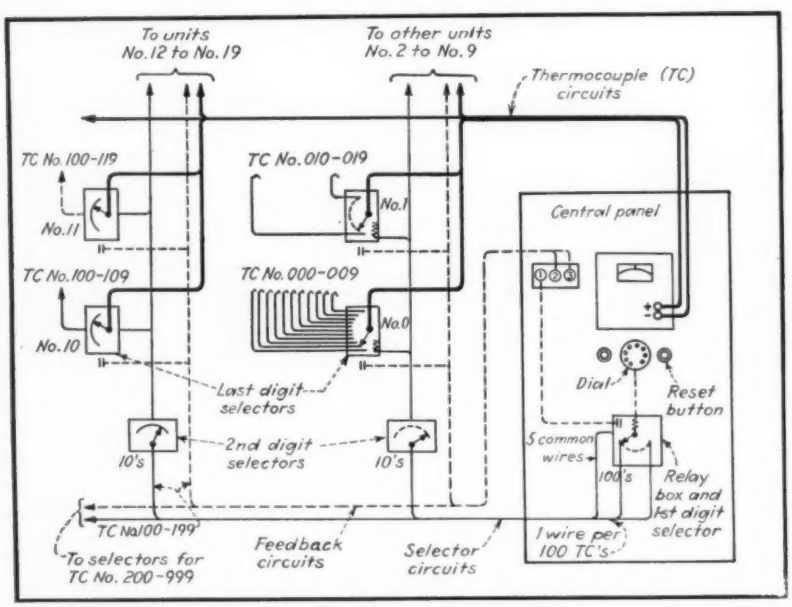

Fig. 1—Any one of 1000 widely separated thermocouples (TC) can be connected to indicator by dialing its 3-digit number. Feedback system warns of "wrong number"

Dial System

This type of circuit is relatively simple and is shown diagrammatically in Fig. 1 for a maximum of 1000 circuits. It requires the operator to dial three figures. The first two operations of the dial select a path on the control circuit to a particular unit switch by which

the final dial operation connects a measuring device to the common bus. Note that the measuring circuit is only through the last unit stepping switch and does not pass through the other two switches in the system.

One feature of this system permits arrangement of the thermocouples on the stepping switches so that the operator may dial the lowest point on any unit switch, such as 321, and then run through the next 9 points by adding one impulse each time. To clear the system for the next reading, the operator must push a release button that resets all switches that have operated to their normal open or "homed" position. Unlike a telephone system, wrong numbers or improper dialing must be brought to the attention of the operator for correction.

Two systems have been developed to meet this requirement:

1. A resistance network with three indicating voltmeters to show the position of each digital unit—hundreds, tens and units.

2. An electrical impulse fed back from a stepping switch to an identical stepping unit with a numbered segment attached. This indicates the number of impulses delivered to that particular stepping switch from the remotely located unit. Here again three units are used to show the position of the digital unit.

The resistance method is used in those monitoring systems where the impulse is supplied mechanically, as on an automatic scanner which operates unattended. Feedback impulse is preferred in those systems where selection is made manually, as in the dial system.

In those installations having two types of thermocouples, an automatic switchover circuit permits the operator to view only the correct scale for the type of thermocouple connected in the circuit for the measurements.

Basic Unit

Basic unit of the system is a ten-point stepping switch with three banks of gold plated contacts. An impulse coil drives three contact fingers. Each impulse advances the switch one point and it is capable of receiving up to 30 impulses per second. A release coil allows the fingers to return to the open position through a spring drive whenever the release coil is energized. An additional contact is operated by the impulse coil armature when the impulse feedback system is used.

Stepping switches are mounted on a bakelite panel which, in turn, is mounted on a steel panel with the necessary terminal blocks. The entire assembly is factory wired with extension leads depending on final service. To date these unit assemblies have been wired for chromel-alumel, iron-constantan and copper-constantan thermocouples, and copper for pressure transducers or motor operation.

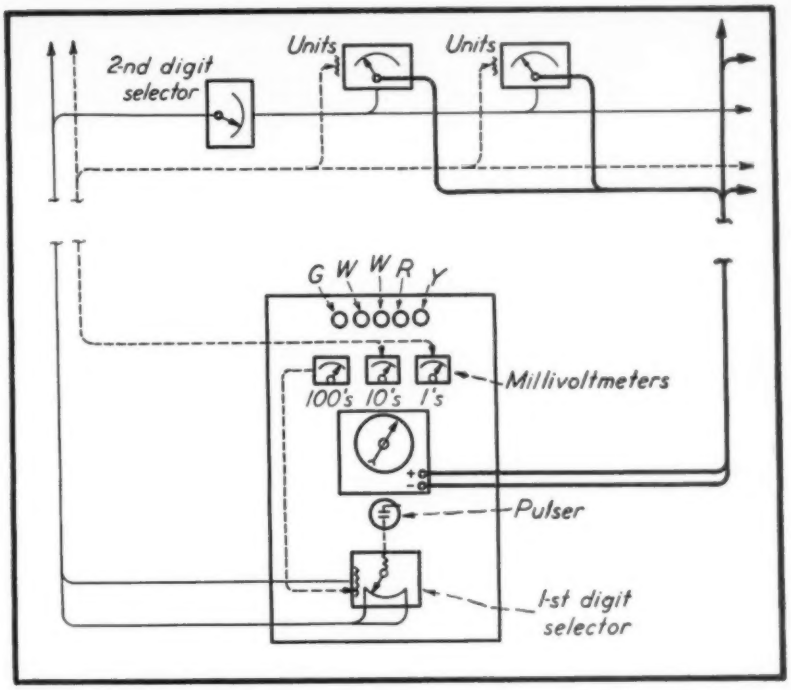

Fig. 2—Scanning system is like dial system except pulser dials thermocouples in preselected order. Resistance network indicates thermocouple number on meters

Scanning System

The scanning system is basically the same as the dial system except that manual operation of the dial is replaced by a timed impulse occurring every few seconds. This system is shown in Fig. 2. An intermediate switching circuit is interposed to reset the various tens and unit stepping switches as the scanner proceeds through its sequence of operations.

Total number of circuits scanned is variable between ten and 800. The measured points are connected to a self-balancing indicator with attached alarm or control mechanisms which may stop the progress of the scanner until it is manually reset by the operator.

The resistance type of position indicator is used with the scanning system. At the present time, one scanning system on 160 tube wall temperatures has been in operation for seven months, 24 hours each day without interruption.

Continuous Indicator

Need for temperature indication on a graphical panel produced the continuous indicator. In this monitoring system, a departure was made from the stepping switch with release coil to a switch with continuous circular drive, having five switch banks and twenty contacts per bank. The system is shown in Fig. 3 on the following page.

Two of the switch banks connect thermocouples to a self-balancing indicator, the other three banks connect selsyn motors to a master selsyn which is positioned by the measuring drum of the indicator through a simple cam arrangement.

A motor-driven impulse timer controls two circuits:

1. A d-c circuit that advances the rotary stepping switch, connecting a thermocouple to the self-balancing indicator, and at the same time, connecting the corresponding slave selsyn to the master selsyn in the indicator.

2. A few seconds later, after the indicator comes to balance, a-c power is applied to the selsyn circuit so that the slave will synchronize with the master selsyn and reproduce the thermocouple reading. A-c power is then removed and the next d-c impulse given.

Thus, one self-balancing indicator is used to continuously indicate 20 points on separate indicators. The cam drive of the master selsyn makes possible a scale expansion in the center of the scale of the 3-in. indicator to the point where 5 degrees can easily be read on a range of 500 to 1500 F.

Survey System

One process required the periodic comparison of eight temperatures in the same plane at ten different zones in a vessel, and a continuous record of

the highest temperature in each zone.

Here the dial system was used with the variation that the output of a stepping switch (one for each of ten zones) was continuously connected to each point of a ten point recorder. Eight thermocouples were connected to the points of the stepping switch. The position of the stepping switch contact was shown by the resistance method, using ten small indicators located immediately above the ten point recorder. The system is shown in Fig. 4.

With the addition of a few standard relays, any recorder point can be switched to any one of its eight thermocouples without disturbing the setting of any of the other points. At all times the arrangement of thermocouples connected to the recorder is indicated to the operator and is logged on the chart using a two digit system.

Control Point Setting

Use of a standard dial system as a means of setting the control point on remote pneumatic controllers has many interesting possibilities. Selsyn motor drives are employed in this application. One master selsyn in the control room can be connected to any one of a large number of slave units and power applied to the system after the circuit has been set up. In this case, the master selsyn synchronizes with the slave driver, since the latter is operating through a gear train.

Electrical feedback into three common busses to self-balancing indicators shows the controlled variable, the control point setting and valve air pressure or position.

A system for remote selection of pumping units has long been needed to complete the instrumentation of large process units. Whenever a pumping unit has failed, it has been necessary for the operator to leave the control house and manipulate valves before a spare unit can be brought into service to keep the operation going.

Remote Pump Control

In a proposed method using the dial system, the circuit is set up for a particular pump and the starting button pushed, which initiates a modified sequence control circuit to open an electrically-operated suction valve, check suction pressure, start motor or turbine, check discharge pressure and finally open an electrically operated discharge valve. All operations in this sequence are checked by a resistance system and show in the control room on a common indicator for all units. This is fed by a common bus system, since only one unit is connected to the control and indicating circuits at any time.

At the present time there are seven dial systems in operation, one scanning system, four survey systems, and one continuous indicator with 16 selsyns. The total number of measured variables in all these systems exceeds 1600.

There has not been one service adjustment made on any of this equipment since it was placed in operation. Some units have been in constant operation for 18 months in hazardous and corrosive atmospheres without any contact troubles.

One feature of all systems described here requires special mention. All switching is accomplished with the operating contacts carrying no load or potential to spoil contact surfaces.

Savings in wire, conduit, fittings, labor, and panel board space become appreciable in large installations of 200 points or more, using this system of local "unit" selectors.

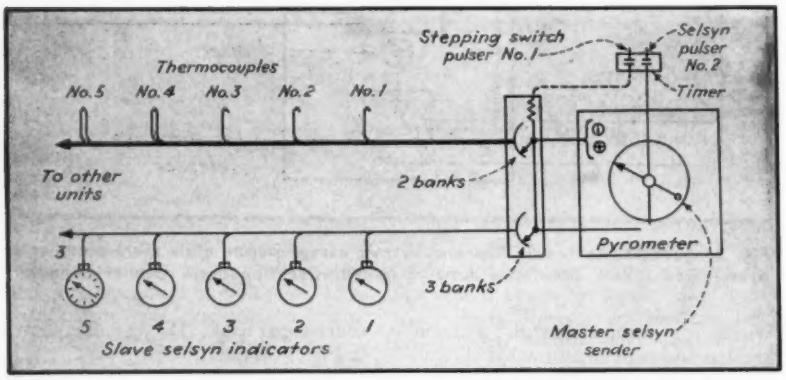

Fig. 3—Pyrometer reading for each thermocouple is reproduced on its slave selsyn until couple is again connected to pyrometer on the next revolution of selector

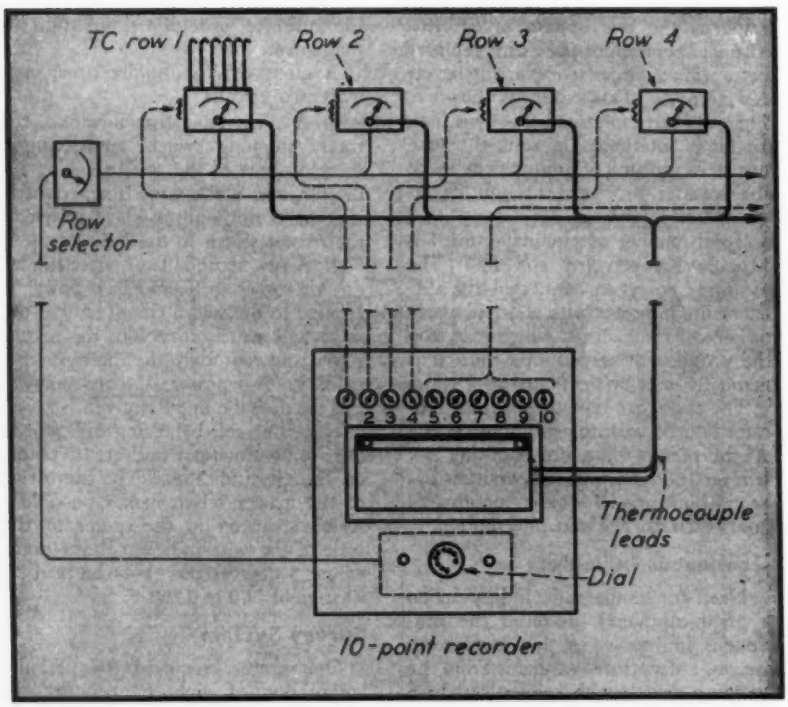

Fig. 4—Eight thermocouples in each row are dialed for periodic check. Highest temperature in each row is continuously recorded. Meters show couple being read

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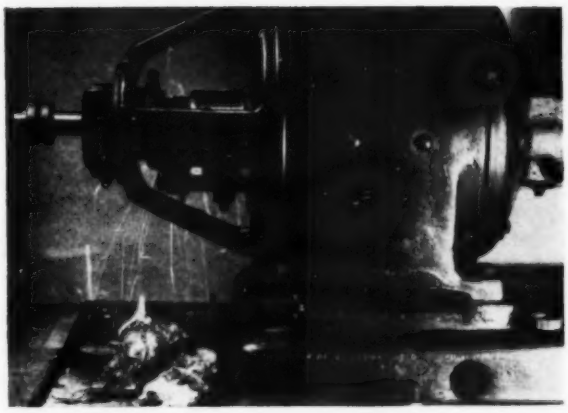


Dust-tight or explosion-proof motors should be used where internal sparking may ignite waste or combustibles, left. Overloads, dirty windings or "single phasing" make motors overheat, right, igniting themselves and surrounding materials

FIRE HAZARDS IN ELECTRICAL SYSTEMS

Study this survey and discover how to use your time and effort most efficiently for fire prevention. Proper application of electrical equipment and concentrated doses of maintenance can help reduce a costly one-fifth of our industrial fires

INSTALLATION of electrical equipment constitutes the leading industrial fire cause, accounting for 19% of the number, and 16% of the total damage of all Factory Mutual fires. Most of these can be prevented, and the problem needs attention because of the inherent hazard of electricity and its wide use in all types of manufacturing plants.

Electrical Wiring

Defective wiring heads the list of electrical fire causes. This is not surprising in view of the extensive use of wiring systems of all types and ages and under every conceivable condition. Wiring systems are exposed to excessive heat, cold, vibration, moisture, corrosion, oil and abrasion. They are frequently severely abused mechanically and often overloaded electrically.

Short circuits or grounds due to insulation breakdown cause most fires that originate at wiring. Wiring systems are planned and proper insulation and equipment are selected to give long trouble-free service. However, occupancies change and the wiring may not be revamped to suit the new conditions. It may become wet or damp. It may be exposed to splashing of corrosive solutions from processes, or to corrosive vapors. Careless use of lubricants or the condensation of vapors may cover the wiring with oil or grease. Abrasive and conducting dusts or metallic chips, as well as non-conducting dusts, may cover the equipment. Fittings and enclosures may be broken either accidentally or through hard service, and maintenance may be inadequate or entirely lacking.

Time and temperature are the two principal enemies of insulation. Continued severe overloading of circuits or equipment with consequent overheating will eventually cause them to fail long before they would have broken down in the ordinary course of events.

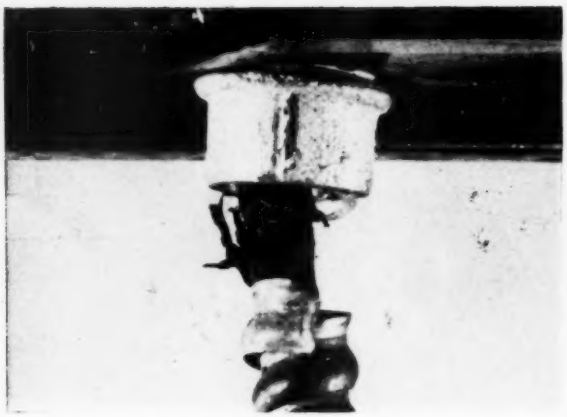
Defects in some types of wiring installations are particularly likely to cause fire. Poor connections where armored cable is attached to switch boxes sometimes allow the cable armor to pull away from the box. Machinery vibration frequently causes the metal edges to wear away insulation and expose bare wiring. An arc could then ignite the insulation, starting a fire which spreads to combustible material in the vicinity. Check connections occasionally and make sure that the armored cable is securely attached.

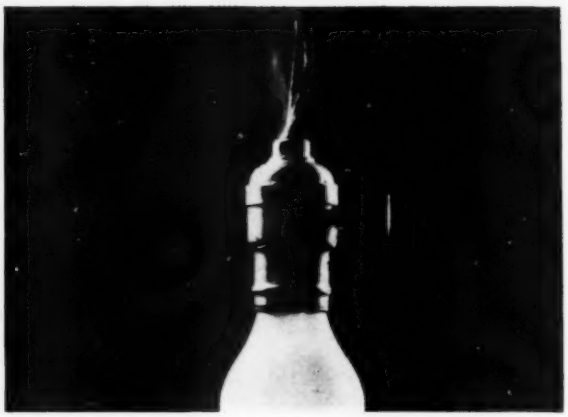
Absense of protective bushings where open wires enter boxes has caused many fires. The insulation becomes frayed and worn, and finally an arc or short circuit occurs, setting fire to oily lint or other combustibles. Extension cords and other portable wiring are frequently kept in use long after the insulation has become dangerously worn. Worn or frayed wiring should be reported to the foreman or electrician, and the condition remedied promptly before fires start.

Another danger point exists where cables with combustible insulation are grouped in a junction box or pull box, cable-way, trench, or manhole. If an arc ignites the insulation, fire is likely to involve all the cables within the enclosure. Even lead-covered cables are

FACTORY MUTUAL SURVEY

	No. of Claims	% of Claims	% of Damage
Wiring	1168	28.6	54.2
Motors	1027	25.2	12.2
Transformers	65	1.6	8.1
Lamps, Elements	437	10.7	7.1
Switches, Controllers	763	18.7	7.1
Electrostatic Equip.	43	1.1	3.6
Generators	53	1.3	2.4
Motor Vehicles	258	6.3	2.1
Fuses	95	2.3	0.9
Miscellaneous	171	4.2	2.3
Total (7-yr Period)	4080	100.0	100.0





Defective wiring is leading electrical fire cause. Worn lamp cord, left, and broken conduit fitting, right, may throw sparks into combustibles below. Heat, moisture, lubricants, corrosion, abrasion deteriorate insulation. Maintenance prevents fires

subject to this hazard as the lead quickly melts and exposes the insulation.

Wherever possible, avoid close grouping of cables. In new installations, if close grouping is necessary, use cables with fire retardant coverings wherever possible. The general remedy for existing installations is to wrap the individual conductors with asbestos tape applied with a 50% lap and then to paint it with a solution of silicate of soda. It is common practice to cover high voltage cables in manholes with asbestos cement applied over a layer of especially prepared felt.

Motors and Generators

Motor fires occur nearly as often as those caused by wiring defects. Many motors are installed in out-of-the-way locations and run even when the plant is unattended. They may receive little or no maintenance. Fires starting at such motors may spread to oily deposits or other combustibles nearby and cause serious damage, although most are confined to the motor.

Many fires and "burn-outs" are caused by overloading, by the use of motors of a type not suited to the operating conditions, by too frequent starting or jogging and similar misuse.

Inadequate maintenance is responsible for many other motor fires. Excessive dirt in a motor clogs the ventilating spaces, makes the motor run hot and eventually causes the insulation to break down, producing a ground or short circuit. Lack of lubrication has resulted in bearings overheating, causing the motor to stall. Increased current then flows through the windings and, if the motor has no thermal overload protection, the windings heat and the insulation finally takes fire. Good maintenance helps to prevent fires of this kind and increases the life of motors. Single-phasing from poor contacts in motor controllers or from a blown fuse in a three-phase supply circuit also causes windings to overheat and "burn out".

All motors should be provided with suitably arranged and properly set protective devices such as fuses, circuit breakers, and thermal overload relays.

Sparks from motors sometimes start fires by igniting flammable vapors or dusts. In locations where this hazard exists, special dust-tight or explosion-proof motors should be used. They are so designed that vapors or dusts cannot come in contact with the sparks or arcs that may occur inside the motor.

Large and important motors, frequently a vital link in a plant's production, deserve the best electrical protection and maintenance. When they "burn out", the fire and electrical damage may run to thousands of dollars and seriously impair plant operations. Keeping spare sets of coils available in case of a breakdown is a desirable precaution against loss of production.

Transformers

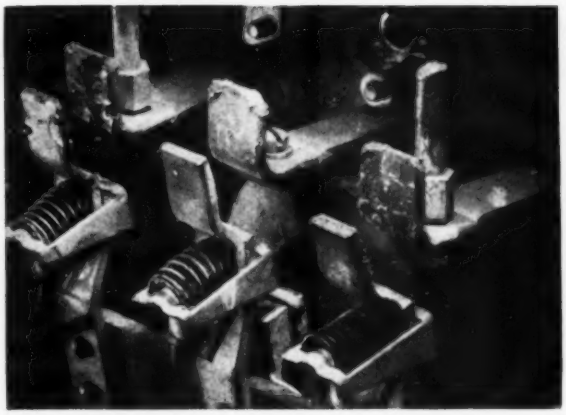
Transformer fires, though rather infrequent, rank third among electrical fires in respect to the amount of damages sustained. Transformer failures occur most frequently from (1) lightning, (2) bushing failures, (3) internal short circuits, (4) loose leads grounding on the tank and burning a hole so that oil escapes and ignites and

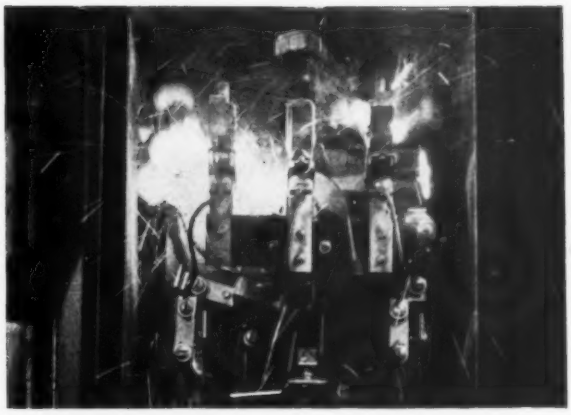
CAUSES OF MOTOR FIRES

1. Single-phasing due to poor contacts in motor controllers or a blown fuse in a three-phase supply circuit.
2. Overloading and lack of proper overload protection.
3. Winding failures caused by dirt, oil, moisture, old age, or mechanical damage.
4. Overheating of amortisseur winding in synchronous motors caused by loss of d-c field excitation.
5. Worn bearings, motor not properly aligned.
6. Improper application.
7. Excessive vibration.
8. Short circuits in leads because insulation is worn or oil-soaked.
9. Puncture of insulation by lightning.
10. Sparks from commutator-type motors.

FIRES AT SWITCHES AND CONTROLLERS

1. Loose connections at terminals causing overheating and arcing.
2. Loose parts causing short circuits or grounds.
3. Excessive arcing due to burned contacts or to low or dirty oil in switches, circuit breakers and starting compensators.
4. Short circuits due to leakage of water, oil, or conducting dusts into switch enclosures.
5. Improper application such as ordinary switches in hazardous locations instead of explosion-proof or dust-tight types.
6. Inadequate interrupting capacity.
7. Unprotected openings such as poorly fitting and damaged covers and missing knockouts in switch enclosures.
8. Severe vibration causing loose connections.





Worn, pitted contacts, left, broadcast fire and molten metal, right. Tight, well-covered enclosures prevent sparks reaching combustibles. Worn contacts also can cause short circuits that may burn out wiring, and "single phasing" that overheats motors

(5) gradual leakage of oil followed by overheating. (The oil level of transformers should be checked frequently and oil temperature kept below 90 C.)

Arcing following electrical breakdowns vaporizes the oil and may create a pressure sufficient to blow off the cover or rupture the casing. When this happens, considerable oil may be expelled, resulting in an extremely hot fire that is difficult to control.

Wherever possible, particularly for indoor installations or where transformers seriously expose important buildings or equipment, special effort should be made to procure the synthetic liquid or dry-type transformers in preference to the oil-insulated type. If the lightning exposure is severe the synthetic-liquid type should be installed in preference to the dry type.

Oil-filled transformers are best located outdoors where they will not damage other property in case of fire. To minimize damage to outdoor installations, support transformers on a drained concrete base with a curb at least 6 in. high and cover the base to a depth of at least 6 in. with coarse crushed stone.

Switches and Controllers

Switches and controllers are likely to cause fires unless they are properly designed and well maintained. Oil switches present additional danger because of the flammable liquid with which they are filled.

If an arc occurs in switch boxes, automatic controllers or circuit breakers, it may be violent enough to blow open the cover if not securely fastened. The intense heat of the arc may produce globules of molten metal which are thrown out from the box and will readily ignite any loose combustible material near by. Boxes of this kind should have tight-fitting covers well secured by hasps, locks or other means.

Lamps and Elements

In locations where electric lamps may be broken or come in contact with ordinary combustibles, wire guards are a desirable safeguard. Presence of vapors or dusts requires special vaporproof or dust-tight globes. Ordinary extension lamps near flammable liquids or in locations where combustible dust or lint exists are particularly hazardous. Under any of these conditions, accidental breakage of the lamp is almost sure to produce a quick, intense fire which can readily get out of control.

The general fire record of fluorescent lights has been good but there has been an occasional, serious fire, usually caused by overheated ballast units at fixtures igniting combustible materials in contact with them. Ample clearance should be provided between fluorescent fixtures and combustible materials except where necessary at the point of attachment.

Unguarded electric elements at portable grills, ranges and industrial oven and tank heaters present a real fire hazard. Heating elements should be well-insulated from combustible construction and arranged so the paint drippings or loose combustible materials cannot come in contact with the hot surfaces.

Fires caused by the hot surfaces of electric devices such as lamp bulbs, pressing irons, soldering irons and enclosed heating elements are classified under the cause "Hot Surfaces," and are not described here.

Electrostatic Equipment

One type of electrostatic air filter consists of electrically-charged filter plates rotating in an oil bath. Unless the plates are periodically cleaned and the oil tanks regularly cleared of sludge, excessive deposits may result in arcing and fire. The need for special sprinkler protection in filter enclosures in addition to the need for careful maintenance has been emphasized by fire experience.

Most fires at electrostatic paint spraying and detearing (removing drips from freshly dipped articles) equipment have been caused by arcing when the work came in contact with, or approached too close to, the charged electrodes. Arcs at poorly insulated or broken wiring have also caused fires. Poor housekeeping has usually been a contributing factor.

Miscellaneous

Fuses are the safety valves on electrical circuits and promptly shut off power and prevent further trouble as soon as some dangerous condition develops in the electrical system. Properly used, fuses prevent passage of electrical currents higher than the wires or equipment can carry safely.

To bridge a fuse is dangerous practice because it permits high accidental currents to cause overheating or arcing, with resulting fire or electrical damage. Fuses of too high a rating involve similar dangers. Use fuses of proper rating and avoid any temptation to bridge a fuse instead of correcting the trouble.

Serious fires have occurred at life-testing racks for radio tubes, small motors, and other electrical equipment. This group also includes fires starting inside radios, electric clocks, rectifiers, induction heating equipment and other special apparatus. A considerable number of electrical fires where data regarding the cause were incomplete are also included.

All electrical installations should be made according to recognized safe practices. Once properly installed, the equipment must be kept in good condition by inspection and adequate maintenance. *Courtesy of Associated Factory Mutual Fire Insurance Companies.*

Fundamental Principles Leading to an

Second and concluding article on cooling tower wood deterioration discusses chemical and bacteriological destruction. Brown and white rot are explained, and combatting methods are given. Factors influencing preserving are: structure, preservative and treatment

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WOOD is attacked by a great many chemicals and is not indestructible. Available information deals with strong reagents and severe conditions, neither of which is likely to occur in cooling towers. One investigation covering this subject concluded that delignification is caused by the presence of sodium carbonate. General correctness of this conclusion has been rather well established.

Sodium carbonate may be present in natural waters or it may be introduced from sodium zeolite water treatment. This process replaces all metallic ions with sodium, producing a water having zero hardness to the soap test. High solubility of sodium salts prevents scale formation, and serious delignification can result from circulating water having 300 ppm sodium carbonate.

High concentrations will cause an attack on the filling and structural parts of a tower. Lower concentrations may not affect flooded portions, but occasional or intermittent splash on louvers will be concentrated through evaporation. The moisture on such portions of a tower may become saturated with dissolved solids. Furthermore, solutions may actually evaporate to dryness, and crystal formation will separate fibers mechanically. Drying of wood impregnated with an alkaline salt causes fiber swelling, which increases wood permeability encouraging further attack.

Both sodium carbonate and bicarbonate are listed as pulping agents. Some authorities contend only the normal carbonate causes delignification in cooling towers. Neither is used commercially because they dissolve hemi-cellulose and degrade alpha-cellulose. This type of wood deterioration probably removes some carbohydrates.

Fig. 1—Chemical deterioration of red wood in a cooling tower. Attack progressed to center of the wood materially reducing the thickness, density and ultimate strength of the specimen

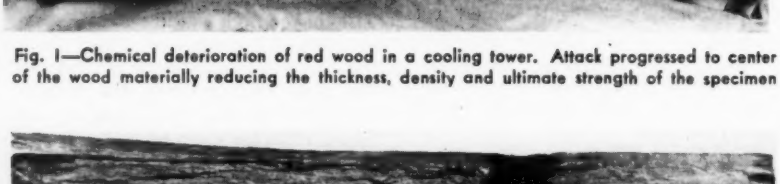


Fig. 2—Brown rot is caused by chemical reaction between wood and iron. Examination of effected specimen surface indicated iron was absorbed into the inner fibers of the structure

Chemical deterioration in flooded portions of a tower will cause a general reduction in cross-sectional area of the lumber, and the surface becomes white as extractives and lignin are removed. Deterioration may remove some of the wood constituents without loosening the fibers, leaving a light-colored porous surface that may attain a depth of a quarter inch or more. Wood subjected to alternate wetting and drying seldom shows this type of attack, but usually has the delignified portions reduced to a soft, loose, fibrous condition.

Sulfur Deterioration

Cooling towers located in a refinery near a sulfuric acid plant had a different type of deterioration. The outer surface was attacked, giving the appearance of hemp. This indicates acid fumes had hydrolyzed the cellulose that left a residue high in lignin.

Wood is slightly acid and a circulating water of 6.5 pH would be the least detrimental. However, few operators can tolerate such a water because of corrosion, but inhibitors will make its use possible. A 7.2 to 7.5 pH is satisfactory for cooling tower operation. The pH should not be lower but can rise to 10 or more. This arbitrary range is selected because acid waters are assumed to be corrosive and alkaline waters form scale.

Presence of sodium carbonate usually results in a high pH, and this has led to the false assumption that the high pH causes delignification. Treatment with sulfuric acid converts the carbonates to sulfate. Alkalinity is reduced, but sodium carbonate removal eliminates the delignification and does not reduce pH.

Some operators have installed sulfur burners to produce sulfur dioxide. This gas converts the carbonates into sulfites, which are not highly soluble and are strong pulping agents, but no ill effects have been noted to date. Chemical analysis of circulating water indicates that either natural aeration or chlorine employed to control algae oxidizes sulfites to sulfate compounds.

Oxidizing Agents

Chlorine or potassium permanganate utilized as algicides should not be overlooked in considering chemical deterioration. Both are oxidizing agents, which will react with tannins, and chlorine will destroy lignin and hemi-cellulose.

Ferrous compounds seem to act as a

Understanding of Wood Deterioration

catalyst in oxidation of hemi-cellulose, cellulose and extractives. Decay has been found in cooling towers at points where the wood is in contact with iron casings. Analyses of the wood disclosed abnormal amounts of iron present. Later microscopic examinations disclosed presence of fungi in all cases. Obviously toxic extractives' destruction by iron allowed the fungi to act. Effect of ferrous salts will be accelerated by an acid condition, and decay adjacent to iron was found only in parts not flooded by the alkaline circulating water.

Biological destruction is actually a chemical attack resulting from microorganism utilizing wood as food. The residue remaining after either a chemical or biological attack is similar in appearance, and distinguishng between the two is difficult. A chemical attack normally occurs at the surface, progressing inward. Fungus attack usually leaves the surface intact, destroying the interior.

Brown and White Rot

Various species of fungi will selectively attack either the cellulose or lignin, and two types of decay have been found. Destruction of cellulose leaves a dark-colored residue, burned or charred in appearance, called "brown rot". Fungi destroying lignin produce light-colored "white rot". Residue in either case is a disintegrated, fibrous material of low density and quite porous. "Brown rot" is the more common type of decay, but attack in cooling towers seems to be about equally divided betwen the two. Dark residue generally occurs at points where the wood was in contact with iron.

Decay makes itself evident by wood strength loss. Such wood becomes brash and easily breaks across the grain without splintering. This condition was found in a tower where rather serious delignification had occurred in the filling, and a microscopic examination disclosed the presence of wood-destroying fungi. Chemicals causing delignification, together with high alkalinity present, could also have reacted with extractives to render the wood subject to decay. Heavy water flow might exclude air necessary to retard fungi growth, but loss in strength resulted from the combined attack.

There is no definite type pattern of cooling tower attacked. Decay has been found in towers constructed of redwood and cypress. Two large refineries having a large number of forced draft towers found decay after 5 to 7 years of operation. In one plant attack was confined to the inner casing of the double-cased exterior wall. In another it was necessary to replace all of the drift eliminators, part of the inside casing and upper structural members.

Fig. 3—Brown rot of this cooling tower eliminator slat started where iron frame contacted the wood. Deterioration of the parts adjacent to the groove was caused by iron absorption

In a large refinery some decay was found in eliminators and partitions while other towers of the same age showed no attack. The attack in this case was prevalent at the bottom while other refineries have found the reverse.

Wood decay is normally more prevalent in low altitudes, possibly because of the higher temperatures and longer growing seasons. This may explain why most of the attacks in cooling towers occur in the Gulf Coast area.

Various species of wood contain extractive materials that are toxic to fungi and impart a high resistance to decay. Impregnating wood with chemicals is often necessary or desirable to increase durability. These wood preservatives may be classified in three general groups: 1. metallic salts carried in a water formulation, 2. hydrocarbon derivatives carried in an oil vehicle, and 3. creosotes. Shown in Table 1 are some of the most common preservatives according to their classifications.

Creosote is probably the best preservative. Its resistance to leaching is considered good, and its toxic qualities are effective as a wood preservative. However, the creosotes do have certain undesirable qualities. The odor might be objectionable in some installations, and

TABLE 1—COMMONLY USED WOOD PRESERVATIVES

Water Formulated Compounds

Zinc Chloride (2-5% solution)
Chromated Zinc Chloride (2-5% solution)
80% Zinc Chloride
20% Sodium Chromate

Sodium Floride (1.5-3% solution)
Mercuric Chloride (1% solution)
Copper Sulfate (0.5% solution)

ZMA (Zinc-Meta-Arsenite)
40% Zinc Oxide
60% Arsenic Trioxide
Acetic Acid (trace)

Green Salts (Erdalith)
33% Copper Sulfate
56% Sodium Dichromate
11% Arsenic Acid

Wolman Salts (Tanalith)
25% Sodium Floride
38% Sodium Chromate
25% Sodium Arsenate
12% Dinitrophenol

Boliden Salts

20 % Arsenic Acid
21% Sodium Arsenate
16% Sodium Dichromate
43% Zinc Sulfate

Chemonite (3.0% solution)

58% Cupric Hydroxide
39% Arsenic Trioxide
3% Ammonia
Acetic Acid (trace)

Oil Formulated Compounds

Bruce Preservative—Beta Naphthol
Phenyl Mercury Oleate
Copper Naphthenate
Chlorinated Phenols

Creosote Compounds

Coal-Tar Creosote
Anthracene Oils (carbolineums)
Water-Gas-Tar Creosote
Wood-Tar Creosote

Fig. 4—White rot of this cooling tower eliminator slat was the result of fungus growth that destroyed lignin in the wood. Residue of this type of rot looks the same as brown rot

handling the lumber frequently necessitates payment of higher labor rates. Fire hazard is greater in this type of preservative. Wood treated should have 6 to 8 lb retention of creosote per cu ft.

Some metallic salts, used in water formulated solutions, are generally quite susceptible to leaching when impregnated in wood. Reagents are added in patented processes such as ammonia, which evaporates after the impregnation and leaves the salts in a less soluble condition. Tests performed on wood treated with chromated zinc chloride salts have shown that when a sealer, such as chlorinated paraffin, is applied over the treated wood, the resistance to leaching is greatly improved. Wood treated with water soluble salts should have a retention of 0.3 to 0.7 lb of dry salt per cu ft.

Several salts listed in this category are extremely poisonous and toxic to persons coming in contact with the treated lumber. Others are quite corrosive to metal. These characteristics are undesirable and should be avoided.

Impregnation of wood by preservatives is influenced by many factors, which may be classified in the following groups: (a) wood structure. (b) type of preservative and application and (c) desired qualities of treatment.

Softwood Treatment

In lumber milled from "softwoods" the preservative tends to travel laterally through the cell cavities known as wood tracheids. Passage from cell to cell is effected through bordered pits, which are valve-like structures occurring in adjacent cell walls. Vertical and radial resin ducts contribute to the passage of preservative into the wood. Vertical ducts are important in facilitating liquid penetration from the ends of the lumber.

Moisture content, at the time of treatment, appears to have a bearing on the degree of liquid penetration. Valve-like structures in the tracheid cells tend to aspirate and close off the entrance to the penetrable membranes through which the liquid must pass. These aspirated cell valves increase gradually as free water in the cell cavities decreases, until moisture content approaches the "fiber saturation" point.

In lumber milled from "hardwoods", preservative travels both laterally and vertically through tube-like structures known as vessels. The valve-like structures do not aspirate and therefore are always free for liquid passage. But, the openings are much smaller than those found on the walls of tracheid cells in softwoods and tend to clog. The vessels have large perforations at both ends and consequently longitudinal movement of liquids is greatly facilitated. Here again these openings may become restricted by extraneous materials and tyloses.

Preservative impregnation of either hardwood or softwood lumber may result in very spotted treatment due to the liquid's inability to force its way or diffuse equally into all adjoining cells.

As a general rule, sapwood can be impregnated with relative ease, while heartwood is resistant to the penetration of preservatives. This may be partially explained by the fact that resins, gums, tannins and natural preservatives, which concentrate in the heartwood area, tend to become hard and partially or completely plug up the vessels, tracheid cells and resin ducts. Tyloses gain entrance into the cell structures through pit-valves and block the preservative.

In selecting a type of treatment and method of application, the impregnation must be evaluated. The amount of preservative absorbed or retained and the depth to which it will penetrate should be known. Penetration possibly should be considered to be a better measure of effectiveness of treatment than absorption. The pounds of preservative retained are considered in terms of cubic feet.

Choice of preservative depends on the carrier since the latter will affect the degree of penetration. Tests indicated water soluble preservatives are taken into the cell walls during treatment to a far greater extent than creosote or preservatives carried in an oil vehicle because of the hygroscopic nature of wood. Difference in penetration may be largely accounted for by variance in viscosities. By treating at increased temperatures, the viscosity can be decreased. This is especially true of the creosote blends and the oil vehicles.

Application Groups

Methods of application fall into three general groups: 1. diffusion in wet wood or capillary rise in dry wood by immersion, 2. hot and cold dip and 3. vacuum-pressure treatment, (a) full-cell process and (b) empty-cell process. Simple immersion will not give sufficient penetration. The second method provides for submerging lumber in a hot bath to expand the air in wood cells. This is followed by submergence in a cold solution, and the preservative is drawn in as air in the cells contracts.

Lumber treated by full-cell process is placed in a cylinder and a vacuum applied to evacuate air from the cells. Solution is introduced and forced into the wood under pressure. As the empty-cell process is not evacuated, part of the solution is expelled when the pressure is relieved.

Desirable qualities of wood preservative may be summarized as follows: 1. resistant to leaching, 2. toxic to wood-destroying organisms, 3. non-poisonous and non-toxic to personnel in contact with the lumber, 4. non-corrosive to metal fittings and 5. economically justifiable. Conditions in a cooling tower are quite severe, and preservatives and methods of application will have to be chosen that best satisfy the variables.

Preservative treatments are available that will protect wood against decay. But, like natural wood preservative, effectiveness lasts only so long as they remain in the wood. This is another instance where test data are lacking because most cooling towers have been constructed of natural durable wood.

MAINTENANCE PROGRAM FOR FIRE ALARM SYSTEMS

Test that alarm system before a fire does. Time and plant activities cause dirty or damaged equipment. This simple step-by-step procedure locates faults and keeps system ready to detect the little fires before they grow to destructive proportions

THOMAS TRAIL

FIRE ALARM systems in the modern plant perform a vital role since they safeguard employes and property and insure uninterrupted production. Consequently, the system should be maintained so that it always will be completely dependable. This can be accomplished only through a planned maintenance program covering every detail of the installation.

There are a number of types of fire alarm systems, each designed for a particular kind of application. These vary from simple non-coded, non-supervised systems for small buildings to complex coded, non-interfering, electrically supervised fire alarm and watchman's reporting systems that record each fire alarm and watchman's report on a perforated paper tape, together with the time and date.

A satisfactory maintenance plan should include periodic inspections of all apparatus and controls, regular tests of all parts of the system, and prompt location and correction of any faults that may develop. A schedule and record chart of all fire alarm maintenance procedures will help eliminate the possibility of details being overlooked, and will serve as a guide in tracing troubles.

Maintenance and test procedure will vary somewhat according to the type of system. On systems employing non-coded fire alarm stations, test the operation of the signals by opening one of the stations with the test key. Each month a different station should be opened, thus serving to test all boxes at least once per year. For more than twelve stations on the system, two or more should be tested each month so as to insure a yearly test for each.

Each time a test is conducted, the operation of every signal device in the system, as well as all control devices, should be noted. Any not functioning properly should be inspected after the test and trouble promptly remedied.

The same procedure is followed where coded stations are employed. The simpler systems of this type use a master coding device actuated by the stations. This is generally supervised to the extent that its spring driven mechanism must be rewound in order to silence the trouble bell. The mechanism of the master coding device should be inspected and oiled sparingly with a good grade of clock oil once a year. Wherever possible, inspect the contacts of non-coded fire alarm stations

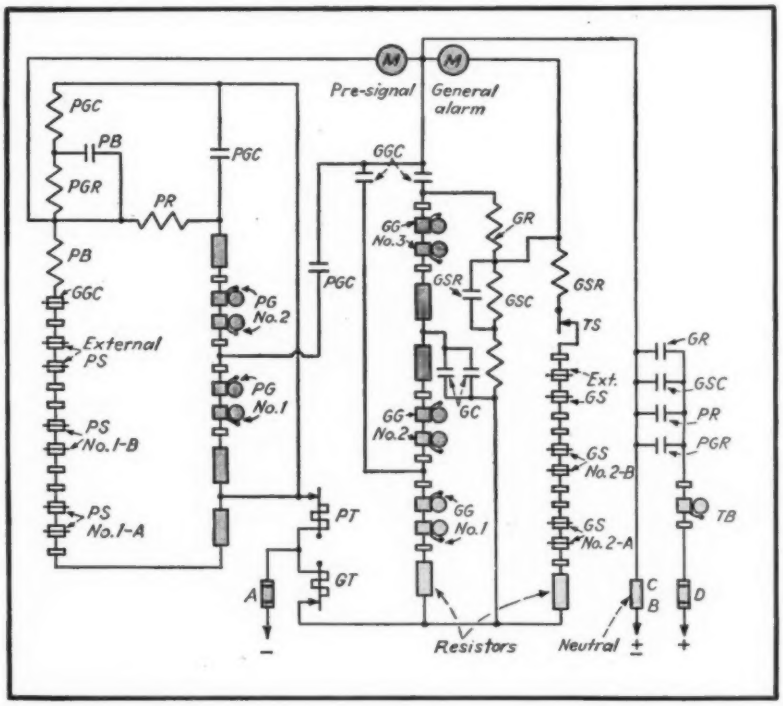


Fig. 1—Schematic diagram of the system helps keep track of test points and circuit constants such as resistance and voltage drops for quicker routine tests

KEY TO SYMBOLS

Pre-signal Components

PGC .....gong contactor
PGR ..gong contactor supervisory relay
PR .....gong supervisory relay
PB .....box relay
PS .....station circuits
PG .....gong circuits
PT .....time limit cut-out

General Alarm Components

GC .....contactor
GSC .....contactor supervisory relay
GGC .....gong contactor
GR .....gong supervisory relay
GSR .....station relay
GS .....station circuits
GG .....gong circuits
GT .....time limit cut-out
TS .....gong test switch
TB .....trouble bell

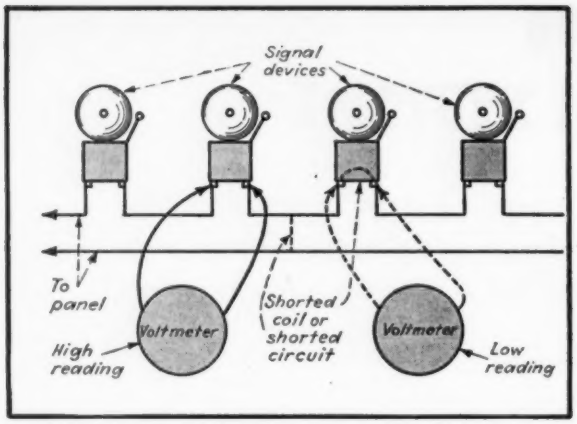


Fig. 2—Shorted coil gives low reading on itself alone, but circuit short causes low reading on all coils beyond fault

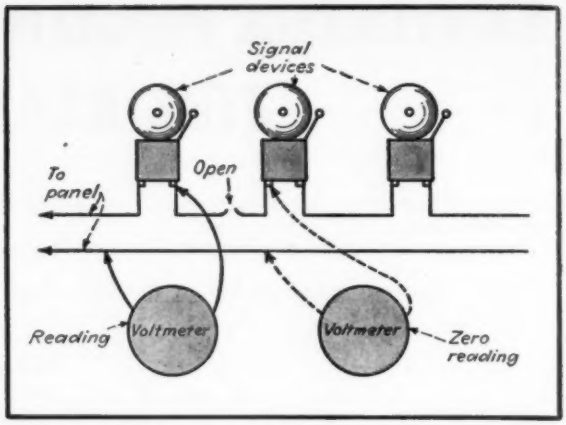


Fig. 3—Open circuit on both gong and fire alarm circuits is between last point giving reading and next giving none

and the master coding device once a year, and remove any accumulations of dust or lint.

All signal devices should be inspected once a year and loose gongs tightened, striking plungers checked for free movement, springs tested for defects, and contacts (where employed) inspected for indications of burning or pitting. Any accumulations of dust or lint should be removed, and all circuit connections, screws and other fastenings checked for tightness. On plunger gongs, it is sometimes necessary to lift out a stuck plunger, clean it with a cloth moistened with carbon tetrachloride, and replace it in its proper position.

Where electro-mechanical bells are employed for signaling, the same maintenance procedure is followed as mentioned for spring wound master coding devices.

Selective Code Systems

Selective code type fire alarm stations are individually equipped with a spring-mechanism for operating the signaling contacts. It is similar to that used on master coding devices and should be given the same periodic maintenance.

This type of station is usually fitted with means whereby a test key may be employed to sound a single stroke on all signaling devices. Generally it is also possible to exercise the station mechanism without sounding an alarm by the use of the test key. One of the methods should be used yearly, either by exercising each station mechanism once a year or one or more of the stations every two months.

The same type of maintenance applies to dual selective code stations, except that usually the single stroke signal test must be made from a test button on the control panel. The station mechanism is exercised in the usual manner by holding the test key at "Box Test" position. A general alarm is sounded by turning the test key to the position so marked.

When exercising the mechanism of any selective code type fire alarm station it is necessary to hold the test key in box testing position throughout the operation of the station mechanism, to prevent the station energizing the signaling devices.

Systems that are connected to a city fire alarm box are usually arranged, through use of a test key, to permit the exercising of the station mechanisms and the sounding of drill signals without calling the municipal fire department.

Where automatic fire alarm stations are employed, no test of the automatic stations is required. They are in the same classification as automatic sprinkler heads, being completely sealed and inspected by the Underwriters.

Control panels should be checked once a year, to determine that the devices are in proper functioning condition. All screws, shunts and wire connections should be inspected for tightness; contacts and operating mechanical parts examined for defects; and any accumulated dust or line removed.

Control Panels

Conditions can be assumed normal if the trouble bell is silent, milliammeters (if provided) read approximately normal current, relays are not unusually noisy (a-c relays produce a slight hum), and the system functions satisfactorily on test. If a milliammeter reads abnormally high on an a-c control panel (more than 10% above normal), it may be due to very high line voltage or supervisory relays which are out of adjustment. The latter is not necessarily important, unless a relay is vibrating loudly or chattering. Where this trouble is present, place a piece of paper in the armature gap and, while holding the gap closed, remove it. Repeat several times until the paper is clean to clear the gap.

Blow any dust from between the movable and fixed parts of the relay with a hand bellows or small electric blower. Tighten the hinge pin screws, but not enough to affect normal operation of the relay. De-energize the relay and see that it releases readily by gravity. If these steps fail to silence the relay, remove and return it to the factory. Adjustments on such relays are very difficult on the job.

High Meter Readings

A high milliammeter reading on any electrically supervised system can also indicate a short-circuit in a signaling device operating coil or elsewhere on the signaling circuit, though the short-circuit may not be of sufficient magnitude to cause the signal circuit time limit cut-out to function and open the circuit. Therefore, if no other cause can be found responsible for the high reading, it is well to sound a test signal on the affected circuit to locate faulty signaling devices, if any.

All other devices actuated by the fire alarm system, or watchman's reporting system, should be checked once a year, or oftener where conditions dictate.

To intelligently locate and remedy troubles that may develop on a fire alarm system it is important to have available as much information on the system as possible. This should include instructions on the installation, operation and maintenance of the particular system, along with wiring diagrams. Usually, the diagram furnished with a system shows actual wiring connections of the control panel. To more

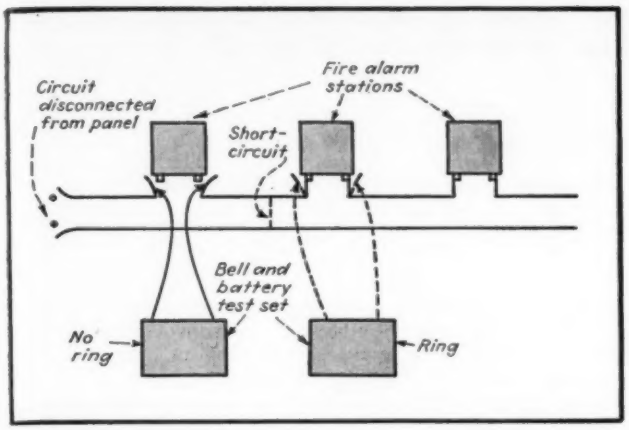


Fig. 4—Each station is disconnected, tested and reconnected to locate short in alarm circuit. Wires are disconnected from panel

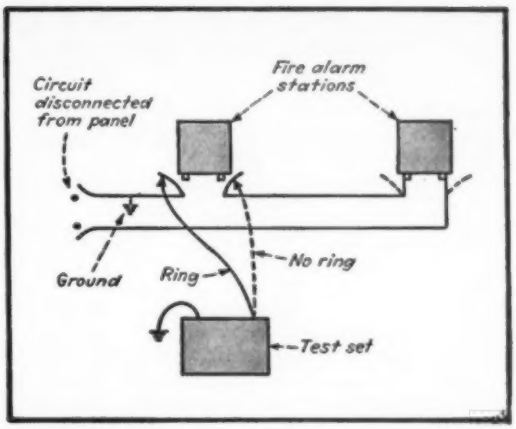


Fig. 5—Starting at end of circuit, successively isolate, test and reconnect stations to locate grounds

easily understand the arrangement of the system, make an elementary or "straight line" diagram, Fig. 1, using the regular diagram as a guide.

On electrically supervised fire alarm systems, various arrangements of relays are provided to ring the trouble bell in case of fault in the system. Generally the bell rings whenever an alarm is sounded, or if a break, short-circuit or ground occurs on either the station circuit or the signaling circuit. In some systems, the trouble bell also rings if a break develops in operating coils of signaling circuit contactors on the control panel. Some battery-operated systems are arranged so that the trouble bell will ring if the battery supply for either system or bell is interrupted, or for an open-circuit developing in the line to the city fire alarm box trip.

By observing which relay or relays are in released position when the trouble bell sounds, location of the trouble source can be more easily determined. For this reason, it is well to identify each control panel relay.

Circuit Resistors

Resistors employed in fire alarm station circuits or in signaling device circuits are usually located on the control panel. It is a good plan to test the voltage drop across each while all parts of the system are functioning normally. A voltmeter is employed for this purpose and the reading across each resistor should be entered on the wiring diagram, where it will serve as a record of the normal value.

In event of trouble, a reading of voltage drop across the resistor in the faulty circuit may be of assistance in checking the source of defect. Zero reading will indicate an open circuit in devices or wiring of that circuit, or in some control unit or wiring on the panel. A low reading indicates high resistance which may be caused by a loose wire connection, poor contact in a circuit device, or a partial short-circuit in the resistor. A high reading indicates a ground or short on the circuit, or a break in the resistor itself.

By connecting a portable voltmeter across signal devices, as in Fig. 2, one unit may show a lower voltage drop than the remainder, an indication of a short-circuit. If the short-circuit is found in the coil, it should be replaced.

Signal Circuit Defects

A test for short-circuit located in the signal circuit wiring may also be performed as shown in Fig. 2. Each signaling device is tested as before by connecting a voltmeter across the terminals. The short-circuit will be located between the last consecutive device with a low reading and the next unit with a high reading, or between the last unit and the terminals of this circuit on the control panel.

If an open in a signaling device circuit is indicated when the trouble bell rings, each unit on the defective circuit should be tested with a voltmeter again as shown in Fig. 2. If the open circuit is in an operating coil of one of the devices, this time no reading will be obtained on any of them until the voltmeter is connected across the terminals of the defective device.

Zero reading on all of the signaling devices may indicate a break in the signal circuit wiring. Fig. 3 shows how a voltmeter may be connected between one of the terminals of each signaling device and the opposite wire of the circuit. The break will be located between the last device on which zero reading is obtained and the next device on which a reading is indicated, or the terminals of the circuit on the control panel.

A voltmeter may be employed to locate an open in a fire alarm station circuit in the same manner as on the signal devices, Fig. 2 and 3. A reading on the voltmeter connected across the terminals, Fig. 2, this time will indicate an open circuit in the station being tested. At each station, the test in Fig. 3 also should be made. Connect the voltmeter to one terminal of the station, and to the other wire of the circuit after removing a small section of insulation. (Always reinsulate the wire carefully after the test is completed.) The break, if existing in the wiring, will be located between the last station with zero reading and the next station that gives a reading, or the terminals of this circuit on the control panel.

Alarm Circuit Shorts

A short-circuit in a fire alarm station circuit may be located as in Fig. 4, after first isolating the circuit. At each station, the wires are disconnected from the terminals and a bell-and-battery test set connected to the wire ends. The wires are replaced on the terminals after each station has been tested. The short-circuit will be located between the last station producing a test ring and the next station without, or the terminals on the control panel.

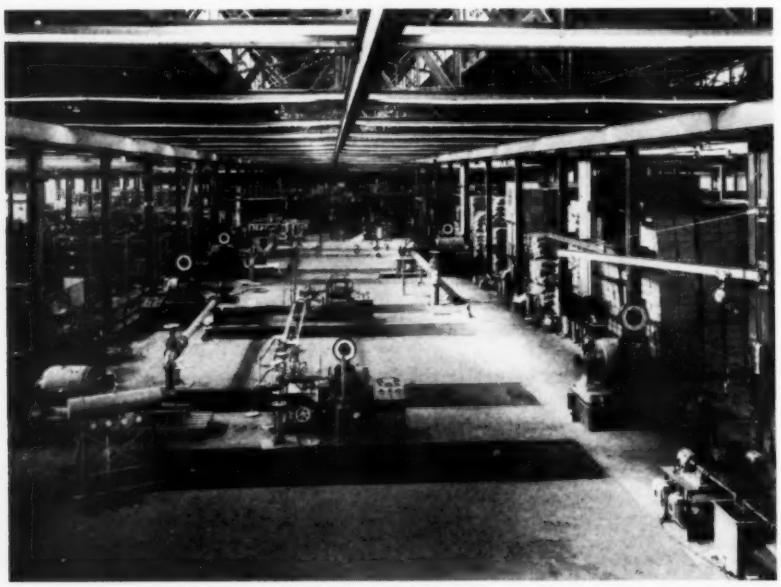
To locate a ground in a fire alarm station circuit, disconnect the circuit from the control panel, and starting at the last station on the circuit, disconnect the wires of each in turn, Fig. 5, connecting a bell-and-battery test set to ground and to first one of the wires then the other. After each test, replace the wires on the terminals before going to the next station. The ground will be located on the section of wire producing a test ring.

In testing dual selective code fire alarm stations, the pre-signal circuit must be tested separately from the general alarm circuit for good results.

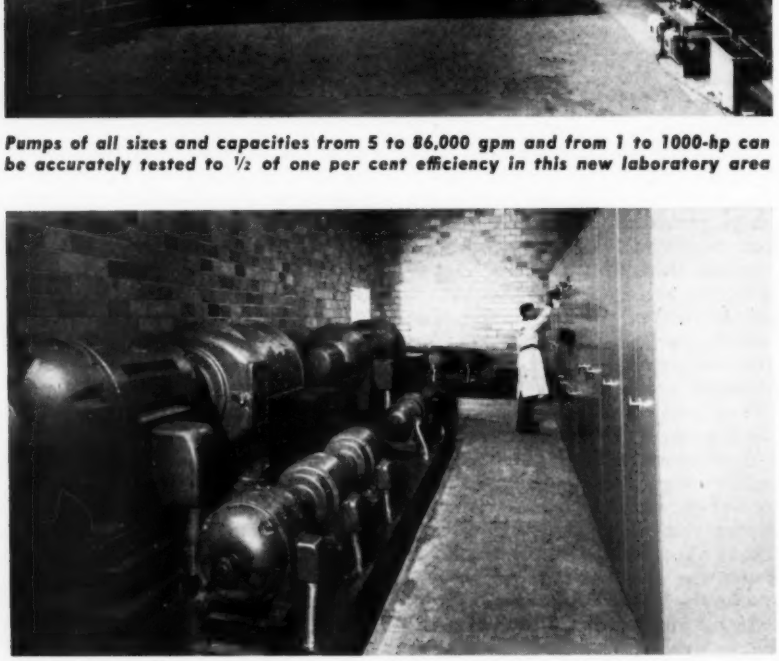
FROM A TAPFUL TO A TORRENT

Quarter-million-dollar testing laboratory occupies over 7,000 sq ft of floor space. It contains eight stations with sufficient equipment to check actual characteristics of wide range of pumps with their calculated performance data

MANY new innovations in advanced test-laboratory techniques and equipment will insure peak product quality, and guarantee matching or exceeding customer requirements of pump performance at the Peerless Pump Div. of the Food Machinery and Chemical Corporation's new pump laboratory at Indianapolis, Ind. The installation establishes a completely new set of standards in pump testing procedures in this field of product manufacture. The laboratory occupies over 7000 sq ft of floor area and includes a total of eight pump stations. Both high and low voltage equipment is available, making use of motors up to 1000 hp in size.



Pumps of all sizes and capacities from 5 to 86,000 gpm and from 1 to 1000-hp can be accurately tested to ½ of one per cent efficiency in this new laboratory area



Motor generator sets, 200-kw units in foreground and smaller sets at rear, can be operated singly or in series to provide current for dynamometer in pumping test

Pumps are tested to obtain performance characteristics, observe operation and to compare laboratory results with calculated and design performance data. This requires measurement of water handled, head against which the pump is operating, input and exact operating speed.

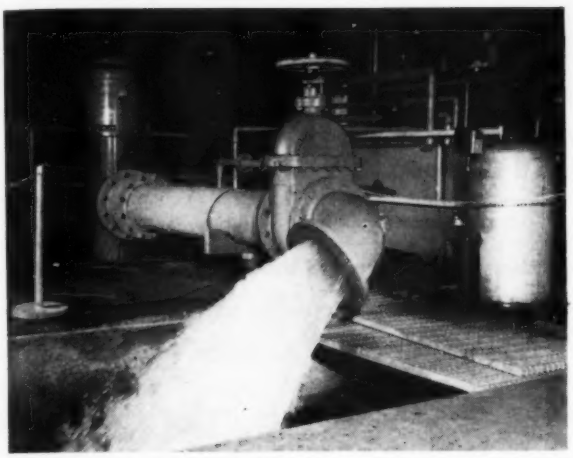
To insure ample water for testing several units at the same time and to provide sufficient volume for large capacity pumps, a test pit 30 ft wide by 192 ft long and 12 ft deep was constructed. At one end a round sump 10 ft in diameter and 40 ft deep makes possible the testing of vertical pumps. A wall in the center of the large pit permits draining one-half for cleaning without disrupting testing in the other half. This also makes possible calibration of large meters by displacement. Based on a 20% recirculation of water, pumps can be tested up to 86,000 gpm capacity at the present time.

Measuring Accuracy

There are several unique refinements in the hydraulic apparatus for greatest accuracy in pump testing. For example, venturi meters have been installed and accurate measurements of capacity are insured within one-half of 1%. Mercury manometers with scales calibrated directly in gpm for each size venturi tube guarantee maximum accuracy in capacity measurements and reduce testing time to the minimum. Each discharge assembly has a straight piece of pipe, at least ten pipe diameters long, installed between pump nozzle and venturi meter. In addition, each discharge contains a pair of straightening vanes located 12 in. above the venturi meter.

Smaller venturi meters are arranged for manifolding in pairs. These pipe assemblies have an additional honeycomb type straightening section installed at the upper end joining the manifold. Thus laboratory readings are more accurate than field tests with their limitations due to restrictions, turbulence and insufficient straight pipe before a measuring device.

Heads up to 100 ft can be measured



Comparison of large 30-hp flood control drainage pump discharge and the small water stream flowing from the faucet

At testing station, operator uses unique control devices to adjust the speed of a high-head horizontal centrifugal pump

with a mercury column calibrated in ft of water to facilitate calculations and eliminate errors. Beyond 100 ft head calibrated bourdon tube gages measure the discharge pressure in psi to any pressure required. The bourdon tube test gages are regularly checked with a dead weight tester to insure highest accuracy of head measurements. Mercury manometers are employed on the suction side of horizontal pumps to obtain direct suction lift readings.

Dynamometer Control

One feature of the hydraulic laboratory is the extremely accurate horizontal cradle mounted dynamometer equipment. These direct current dynamometers are controlled by amplidynes with electronic pre-amplifiers. A 10-, 25-, 75-, 200- and 450-hp dynamometer with operating speeds up to 4500 rpm provides a wide selection of sizes. Since pump capacity varies directly as the speed, the head as the square of the speed and the horsepower as the cube of the speed, even a small speed fluctuation during a test can greatly increase errors between capacity, head and horsepower readings.

Prior to purchasing the dynamometers many different methods now being used to properly control the speed on pump drives were studied. Several pump testing laboratories have improved on the old manually adjusted d-c dynamometer common in the pump industry by using a differential gearing mechanism, which compares pump speed with a constant reference. This method of constant speed control is quite accurate, but carries with it a certain amount of inertia. The electronic speed regulators maintain speed within less than ½% of pre-set pump speed, even following severe torque fluctuations.

Switch gear and motor-generator equipment is housed in a separate enclosed fireproof, dust-proof room. Motor-generator sets are designed to produce d-c for the dynamometers, and they are electrically controlled in conjunction with amplidynes to insure constant and accurate speed control.

This regulating system consists of a small alnico generator, connected to the dynamometer, which puts out a voltage signal directly proportional to motor or pump speed. The signal is fed into an electronic pre-amplifier, which regulates the voltage on an amplidyne generator controlling the main generator field. Dynamometer speed is regulated by controlling the main generator voltage.

With this equipment, any desired speed can be set at the dynamometer control desk. A complete set of head, capacity, and horsepower readings can be made at a given speed without changing the control adjustment on generator or d-c driver. Since the speed is held constant by automatic devices, capacity is read directly in gpm and head is read either in ft of water or pressure, no further calculations are necessary.

Observation of all operating characteristics of the pump under test can be made instantly. Practically no fluctuations of the operating speed exist, and accurate readings are obtained throughout the test.

Each dynamometer station has a master control desk from which the test engineer can start and stop the machines and adjust speed. The control desk also contains electric chronotachometer equipment that includes an approximate rpm meter, a high accuracy revolution counter and electric timer, which enables the recording of average pump speed over a period of time. With this highly accurate rpm reading and the dynamometer torque reading, the horsepower easily can be figured.

Standard practice at this laboratory includes making complete running tests of all engineered horizontal pumps prior to shipment. This insures their accurate and reliable field operation. In addition, the laboratory will be the site of future development for new and still better pumping equipment.

Moisture in Motors

Failure to dry out winding insulation of motors after prolonged idle periods has been the cause of numerous failures, particularly in the seasonally operated plant. Moisture absorption can be prevented by keeping temperatures above the condensation point.

Electrical space heaters are suitable for this purpose since they are available in various sizes and can be placed in service quickly at low cost. The heaters should be located under the motors to give even heat distribution and precautions against fire.

Amount of heat required to raise the winding temperature 5 C above ambient is given by:

$$H = \frac{DL}{35},$$

Where H is the heat, in kw; D is machine end-bell diameter, in ft; and L is the length between end-bells, in ft.

If moisture hazards cannot be avoided, drip-proof, splash-proof or totally-enclosed motors can be selected. Particular attention to this subject is important when selecting new equipment.—The Locomotive.

FACTORS MOST HANDBOOKS FORGET IN FLUORESCENT LIGHTING CALCULATIONS

Here are the reasons standard lighting calculations give results that vary from actual intensities after installation.* Low calculated values call for expensive extra equipment, high values will result in inadequate illumination on the work

BENJAMIN SCOTT BENSON, Jr. and ERICH H. CHURCH
Benjamin Electric Manufacturing Company

INFLUENCING factors, either unknown or ignored in lighting calculations, are often responsible for actual illumination results being considerably different from those calculated in the best handbook tradition. They are generally, but not always, due to the effects of external conditions upon the light output of the fluorescent lamps, the combination of lamps with luminaires and, as the end result, the amount of illumination reaching the work plane.

This discussion purposely omits maintenance, bacause it does not explain the difference so often encountered between initial calculated illumination and initial achieved illumination (after aging 100 hr).

There is some variation in the lumen output of the fluorescent lamps themselves. For example, a 40-w, T-12, 48-in. white, preheat lamp is usually rated at 2320 lumens at 100 hr of burning. A half-dozen lamps of this type selected at random from a standard package, carefully aged 100 hr and calibrated in a 150-in. integrating sphere indicated a range of lumen outputs between 2331 and 2444—the high delivering approximately 5% more and the average 2-½% more than the rating. This indicates the possibility that at least a portion of the difference between calculated and actual illumination could well be due to the chance selection of lamps.

Ballasts, Luminaires

For any of the more commonly used lamps, there are a great many types and makes of ballasts available. A study of the rated electrical characteristics of ballasts for a given lamp reveal considerable divergence between watts loss, ballast current rating, lamp current, power factor, etc. Electrical tests show an even wider divergence.

Ballasts of various types and makes were selected at random and tested in a two-light, closed-end, industrial luminaire. With a constant ambient temperature of 80 F and 118 v supplied to the ballasts, the following results were obtained:

Two conventional pre-heat ballasts, while of different makes and ratings were of the same general type and gave practically the same results.

Two ballasts used with instant-start bi-pin lamps were of different make, rating and type. Output for one was 3.3% high.

Five ballasts used with instant-start single-pin lamps were of different make, rating and type and included the two ballasts used with the instant-start

*Abstracted from paper presented at the National Technical Conference of the IES, Pasadena, Calif., Aug., 1950.

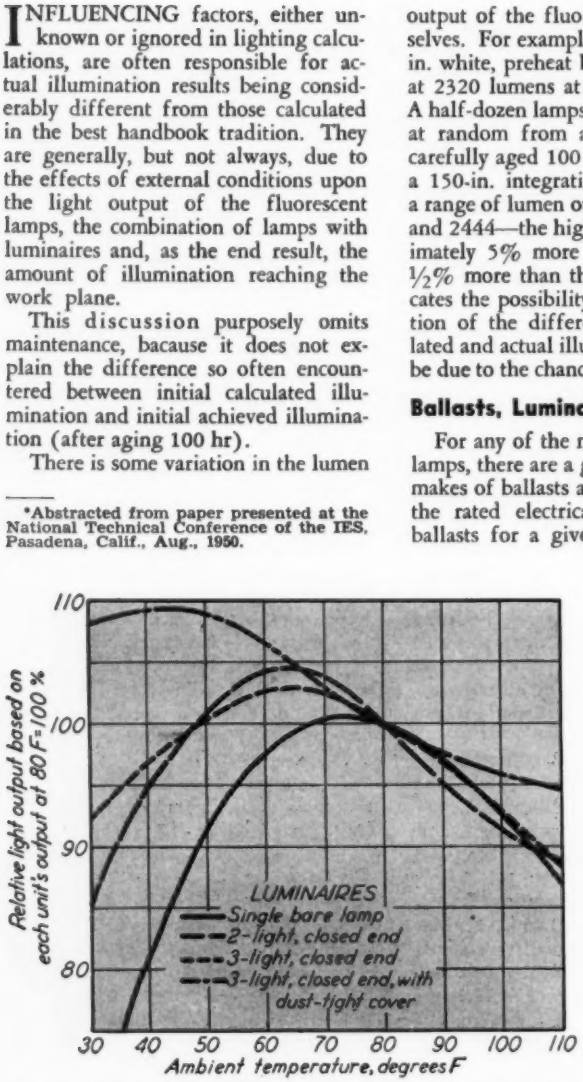


Fig. 1—Variation of light output with ambient temperature shows inefficiency in warm spots often found near ceilings

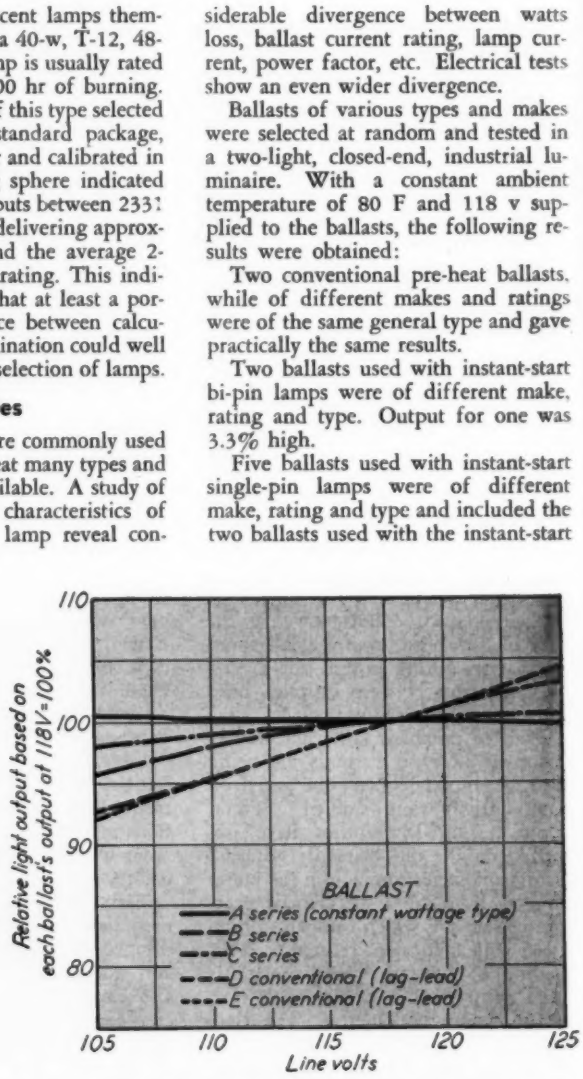


Fig. 2—Some ballasts are more susceptible than others to voltage changes. Only the change in output is plotted here

bi-pin lamps. The use of ballast C, while of the same general type as ballast B, resulted in only 85% as much light under identical conditions. Similarly, using ballast D resulted in only 94% as much light as ballast E. Output for all five ballasts varied between 87.9% and 110.5% of test standard.

Manufacturers are constantly striving to increase the light output efficiency by raising the efficiency of the reflecting surface. Minimum values are usually set in accordance with accepted standards. Maximum values are limited only by such practical considerations as economics and durability.

A three-light, closed-end industrial luminaire type for 48-in. T-12 fluorescent lamps usually has a mean light output efficiency set at 72%. Samples of production may run consistently higher than this value by 5 or 6%. When using a coefficient of utilization table based on light output efficiency of 72%, this difference can well show up in the result.

Temperature, Drafts

Fluorescent luminaires are photometered at an ambient temperature of 80 F. Light output of both the two- and three-lamp closed-end fluorescent industrial type luminaires was investigated under a wide range of ambient temperatures with rated voltage applied to the ballasts which were of the conventional (lag-lead) preheat type. An additional test was made of the three-lamp luminaire with a clear dust-tight cover to investigate the effect of completely enclosing the lamps. Ambient temperature was closely controlled by placing the luminaires in a heat-cold chamber.

Results of the temperature tests (in still air) are shown in Fig. 1. For comparison purposes, one curve is based on information according to Forbes and Diefenthaler for a bare 40-w, 48-in., T-12 lamp. As could be expected, the relative light output peaked at a lower temperature for the enclosed three-light luminaire than for the same unit less the cover. Contrary to what one might expect, the corresponding two- and three-light luminaires tested peaked at approximately the same ambient.

Location

In an industrial plant, temperatures near the ceiling (where the luminaires are often installed) may be 20 to 30 deg warmer than at work-level. This means that the lighting equipment may be operating in an ambient temperature roughly 10 to 20 deg warmer than that at which they were rated. Certainly the drop in the light output indicated for these elevated temperatures is of sufficient value to affect appreciably the resultant illumination.

Data on draft effects on fluorescent lamps both bare and enclosed in tubing are available. Drafts undoubtedly have some influence on the light output and a study of this nature should include the effects not only of air velocity, but direction and humidity as well. The application of such data to an installation would be difficult.

Unless otherwise specified, fluorescent photometric tests are based on a line voltage of 118. Some ballasts indicate this voltage on their cases while others show a range of 110 to 125 v.

Line Voltage

A series of tests was run on a two-light, closed-end, industrial fluorescent luminaire with 48-in., T-12, single-pin lamps and using the five instant-start ballasts previously mentioned. With the ambient held constant at 80 F the voltage to the ballast was varied from 105 to 125 v. Results of these tests are shown in Fig. 2 in terms of relative light output when output for each ballast-lamp combination equals 100% at 118 v.

From Fig. 2 it can be seen that all of the series ballasts had less fluctuation in light output than the conventional (lag-lead) ballasts. The curve was plotted in this fashion for the purpose of convenience in studying fluctuations of individual ballasts. For a comparison of actual light output performance of one to the other, Fig. 3 has been included. In this curve, the ballasts tested assume their actual relative positions. Available voltages between 105 and 110 v are not uncommon and voltages as low as 90 not unheard of in industrial plants.

Fig. 4 illustrates the relative light output plotted against line volts for a three-light closed-end industrial luminaire at ambient temperatures of both 80 and 115 F. For this particular luminaire, there is less change in voltage at 115 F than at 80 F.

Lighting Calculations

The loss of light due to atmospheric absorption in an interior that is clean and well ventilated is, for all practical purposes, nil. In many industrial plants, the presence of dust, smoke, steam and fumes may lower the amount of illumination reaching the work plane by an amount which depends on a great many variables. For certain industrial areas, factors should be shaded slightly to provide at least a degree of compensation.

Average illumination values based on "point-by-point" calculations will

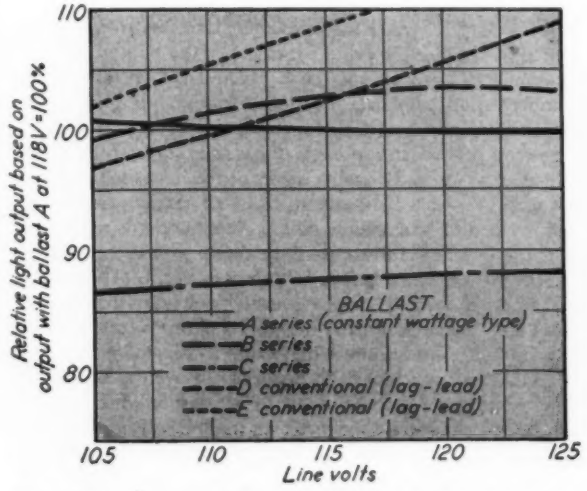


Fig. 3—Comparing actual outputs against ballast A, graph shows wide range of light from different ballasts, voltages

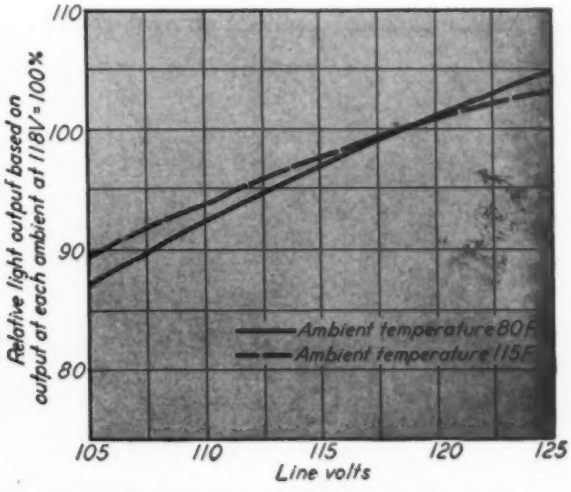


Fig. 4—This luminaire's output changed less at the higher ambient, but actual output will be much lower as in Fig. 1

usually be lower than that actually received since the reflections from walls, floor and ceiling are ignored. For this reason, the "lumen method" of calculation, which takes reflections into consideration, is ordinarily used.

To illustrate how the unwary may be trapped, the examples in Table 1 are given. They are based on the use of the two-light industrial fluorescent luminaires in rooms having reflectances for ceilings of 50% and walls, 30%. Room index values have been taken from Room Index Table 8-3, IES Handbook.

According to example 1, generous increases in room dimensions and substantial reductions in mounting heights when comparing rooms A and B or rooms C and D make no difference in the coefficient of utilization. However, there is a narrow zone (between rooms B and C) where increasing the room dimensions but 12 in. each way and lowering the mounting height only 6 in. decreases the coefficient of utilization by over 25%.

According to example 2 a change in mounting height of 30 in. or more makes no difference in the coefficient of utilization when comparing rooms W and X or rooms Y and Z. However, the decrease of only 6 in. in mounting height for room Y compared to room X increases the coefficient of utilization by almost 21%.

"Borderline" rooms such as B and C and X and Y can introduce errors of considerable magnitude into lighting calculations if the room index tables are religiously followed without interpolation. At the present time the IES is working on new tables which will aid materially in relieving the present ambiguities of the system.

Conclusions

There are other factors which could be mentioned if space permitted. It is believed, however, that the ones discussed are quite representative of the variables present in fluorescent lighting applications.

While this paper reports the results of samplings, which may be inconclusive, it does point out these needs:

1. A standardization of performance (consistent with quality) of ballast equipment.

2. Photometric tests of luminaires based on the light output of the lamp-ballast-luminaire combination rather than on the assumption that the lamp-ballast combination gives rated lumens.

3. The development, when possible, of fluorescent lamps that will deliver peak light output higher on the temperature scale.

4. Further study of the combined effects of temperature and line voltage on the light output of the actual lamp-ballast-luminaire combinations so that correcting factors can be applied where required in lighting calculations.

5. Greater refinements in the "lumen method" of calculations—particularly in the room-index tables.

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TABLE 1—EXAMPLES USING ROOM INDEX DATA

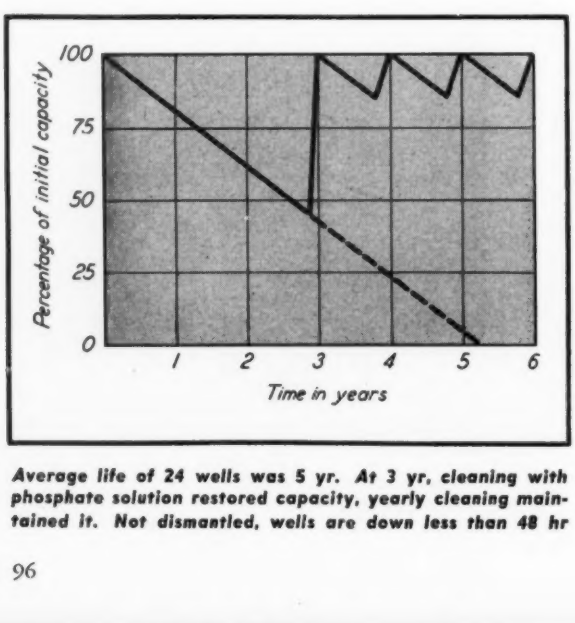
EXAMPLE 1

Room	A	B	C	D
Room dimensions, ft	22 x 30½	26 x 41½	27 x 42½	33 x 59½
Mounting height from floor, ft	16½	12	11½	9
Room Index	G	G	D	D
Coefficient of utilization	.51	.51	.64	.64

EXAMPLE 2

Room	W	X	Y	Z
Room dimensions, ft	30 x 50	30 x 50	30 x 50	30 x 50
Mounting height from floor, ft	16½	12	11½	9
Room Index	F	F	D	D
Coefficient of utilization	.53	.53	.64	.64

Phosphate Solution Restores Capacity of Water Wells



Average life of 24 wells was 5 yr. At 3 yr, cleaning with phosphate solution restored capacity, yearly cleaning maintained it. Not dismantled, wells are down less than 48 hr

●Capacity of water wells usually decreases over a period of time because the porous surfaces at the bottom and sides become clogged by silt, clay, precipitated metallic oxides and calcium carbonate. Vitreous sodium phosphate, commercially known as Calgon, dissolved at the rate of 16 lb per 100 gal of water *in the well* has been successfully used to disperse some and dissolve others of the deposited materials.

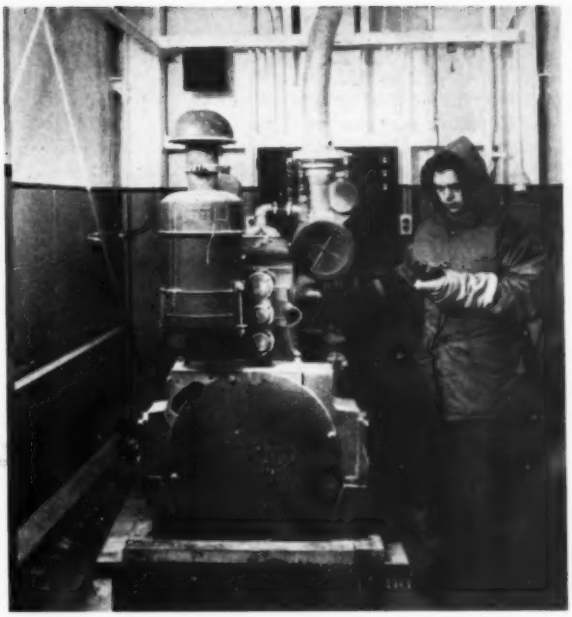
Salts are added directly to the well casing, or dissolved and piped to inaccessible wells. Well water is agitated by rapidly starting and stopping the pump so that the level just reaches the surface before falling back again. This surging is repeated about 12 times in every four hours for a period of 24 to 48 hours. Finally the well is pumped and thoroughly flushed to waste until the water is cleared.

Calcium hypochlorite to disinfect the well is added with the salts where bacterial growths are suspected.

Simple, quick and inexpensive, the method has been used on wells with porous concrete casings (which made acid cleaning impracticable) as well as on gravel packed wells. Because clay and silt are dispersed, it is also expected to produce substantial savings in the development of new wells.

DIESEL TESTING LAB NOW PRODUCES SUB-ARCTIC CONDITIONS

Latest developments in cold-room testing cells have been incorporated in this research laboratory. Temperatures as low as 65 F below zero are possible



Moisture is controlled, and frost is no handicap. Frost was produced in this cold-room test cell for demonstration

SUMMER heat waves never worry the cold room specialists at Caterpillar Tractor Co. where the thermometer often dips to a frigid 50 F below zero.

Several years ago a cold room was added to the facilities of the research department. Because the requirements of research cold rooms differ in so many respects, there was no one design that could be followed as a pattern. The Caterpillar facilities were designed to meet the particular needs of its product.

The recently completed cold rooms were constructed for the purpose of testing machinery under conditions found in the coldest parts of the world. Two rooms are designed to produce temperature as low as 65 F below zero.

Over five miles of pipe are packed overhead and a mile or more runs underneath the floor. An array of panels located outside of the cold room controls safety devices, room temperature, operation of doors and contains recording instruments for research data. A separate machinery room houses the refrigeration compressors and other equipment for holding these sub-zero conditions.

To prevent the large two-ton fifteen-inch thick doors from freezing shut and the need for waiting hours for the ice to melt, electric defrosters have been installed to do the job quickly and efficiently. The large doors push shut by hand to a certain point and then an air control takes over and closes them securely. A vestibule is provided for personnel to permit gradual acclimation to the cold.

Two separate sections of cork board and foam glass assembled with reinforced concrete plaster insure the minimum heat leakage through the 15 in. thick walls. Holes high up in the walls are sealed with copper wool so that the air can "breathe" through these vents when closing the doors.

Scientists and technicians in the laboratory are given medical examinations prior to taking up cold room activities. This is a routine precaution to insure proper health protection of personnel working at low temperatures.

Air Force-type flying suits, electrically heated, are worn. Exposure time to the cold is limited to from two to four hours depending on the temperature and project under study. A two-way sound system eliminates the need for taking notes inside the room. Instead the observer inside communicates the test data to a co-worker in comfortable surroundings outside.

While frost can readily be produced, most of the time the rooms are kept in a defrosted condition. For that reason the casual observer looking through the heavy five pane windows of the cold room sees little of anything to indicate extreme coldness.

A research facility such as this is extremely costly to construct and it is also costly to maintain in operation. However experience gained in the cold room is of great value in solving the problems connected with the operation of machines under extremely cold conditions.

Two-way communication system saves taking notes in the extremely cold atmosphere. Research engineers take rigid physical examination prior to being selected.

A surprisingly large percentage of industrial fires are caused by welding and cutting operations in maintenance and construction work. Here are steps that should be taken to organize and train plant personnel in order to keep those sparks under control. Consequent reduction of frequency and severity of fires can avoid excessive plant losses

This welder knows that sparks are flying but it may be too late before he can see, and get to, a fire such as frequently caused by them

MAINTENANCE PRECAUTIONS AVOID WELDING AND CUTTING FIRES

OPERATORS who use cutting and welding torches do not always appreciate the serious fire hazard of the globules of molten metal that are produced. These bits of hot metal may travel 25 feet or more, some of them hold heat for a considerable time, and they readily ignite any light combustible material which they contact.

Ninety per cent of the industrial fires involving cutting and welding are from "sparks," and only ten per cent from the heat of the torches or from failure or abuse of the equipment.

Cutting and welding annually cause between three and six per cent of all fires in industry. Such fires are particularly common during a period of industrial expansion; cutting and welding lead the list of fire causes in buildings under construction—where these treacherous sparks cause three out of every ten fires on the job.

Sparks from welding equipment have set fire to all kinds of combustible materials such as oil waste in pits, burlap wrappings on stored goods, tarpaulins, paint residue, rags, waste paper, excelsior, paper chips, and wood refuse.

A close study of cutting and welding fires shows that the globules of molten metal often drop unnoticed through cracks, pipe holes, or other small openings in floors or partitions, starting fires out of sight of the operators or men stationed to watch.

Make sure especially that contractors are alert to the danger and take suitable precautions. At one automobile plant, a contractor was using a cutting torch to remove steel sash. Sparks which entered a service tunnel through a ventilating opening ignited oily deposits and combustible pipe coverings. Fire in the tunnel was put out only after three hours of very difficult fire fighting, and plant operation was seriously interrupted as a result of it.

A storehouse is a particularly undesirable place for cutting and welding operations because of the high values usually encountered. One-third of all industrial fire loss is in storage areas, and cutting and welding causes about one out of ten of these storage fires. Cutting or welding ordinarily cannot be done safely near combustible storage, and other means of doing the work may be necessary unless the storage is moved. A typical example was a serious fire that occurred when welding sparks flew beyond a small partitioning tarpaulin and ignited bags of stored sugar, which burned rapidly and resulted in the loss of $50,000.

The real danger comes in the use of portable equipment consisting of tanks of oxygen and acetylene, with the necessary regulating valves, hose, and torches. Since this equipment can be readily moved about, it is frequently taken to locations where its use is defi-

nitely unsafe, or where extreme precautions are necessary.

Plan Work Carefully

It is unwise to leave the decision of whether or not cutting and welding may be done to the judgment of the operator. The only safe way—as experience has amply demonstrated—is to insist that the proposed work be carefully reviewed by a competent supervisor before it is started. This supervisor may be a specially appointed welding foreman, the fire chief, plant engineer, or master mechanic. He should carefully examine the location and specify the precautions, or prohibit the work and insist on other methods if conditions cannot be made safe.

Fires have occurred where men have appreciated the hazards and taken some precautions which, however, were inadequate. Sparks have found their way under asbestos or metal shields and have ignited combustibles which the shields were intended to protect. Small fires started by sparks have sometimes smoldered unnoticed until workmen have left, and then burst into flame. These possibilities must be considered.

The following suggestions are based on actual loss experience, and are offered as a guide for safe use of cutting and welding equipment in industrial plant maintenance and construction.

Supervision

Appoint a competent supervisor to have responsibility for the safe use of portable cutting and welding equipment, and give him authority to establish and enforce suitable precautions. Allow cutting and welding to be done only with his written approval, in safe areas, and by experienced operators.

When outsiders are called in to do cutting or welding, insist that they be subjected to the same system of supervision and precautions.

Automatic Sprinklers

Always keep automatic sprinklers in service when cutting or welding. If sprinkler systems must be shut off for any reason, see that cutting and welding jobs are stopped while protection is impaired.

Safe Locations

It is much safer, and often easier and quicker, to remove a part from a machine and take it to a safe welding or cutting location than to attempt to remove or protect combustibles exposed to cutting or welding in the area where the machine is located.

Dangerous Locations

If repairs must be made in a location that has contained flammable liquids, gases, or combustible dusts, extreme care should be used to remove all the combustible material and to ventilate the area thoroughly.

Tanks and Dust Collectors

Do no cutting or welding on tanks that have contained flammable liquids without adequate purging, or on ducts which may contain combustible deposits without first making sure the ducts are clean. Never use cutting or welding equipment on cloth-screen or bag type dust collectors without first removing the screens or bags.

Combustible Construction

Avoid use of portable cutting and welding equipment in combustible buildings unless they are protected against fire, and floors and partitions are tight. Sweep floors clean, and wet down wooden floors or cover them with sheet metal or equivalent. Prevent sparks from outdoors entering windows, doors, or other openings.

Combustible Material

Before starting work, move any combustible storage or equipment at least 35 ft away. If it cannot be moved, protect the material against sparks by using asbestos or sheet metal curtains or guards. Shut down processes exposing combustible fibers or materials. Remove dust deposits which may be exposed to sparks from nearby operations.

Extra Precautions

Station extra men with a small hose, chemical extinguishers, or fire pails to see that sparks or drops of hot metal do not lodge in floor cracks, pass through doors, windows, or other openings in walls or partitions, drop through openings such as pipe holes to the floor below, or pass over or below curtains or guards protecting combustible materials. *Continue watch service at the scene for a half hour after operations,* to make sure stray sparks have not started smoldering fires. Carefully inspect floors above and below, and adjoining rooms.

Maintenance of Equipment

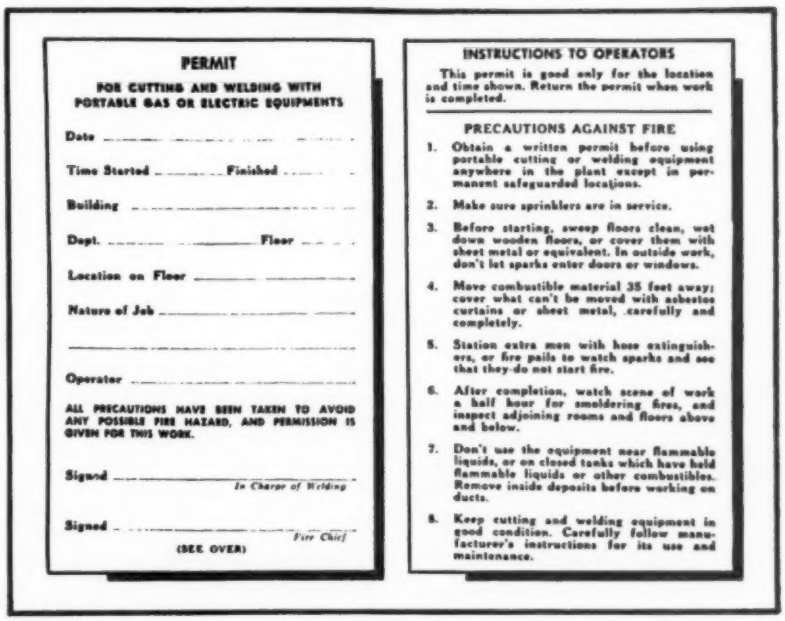
Follow manufacturer's instructions regarding the use of cutting and welding equipment, and keep it in good condition. Give particular attention to the proper gas pressure, and protect the hose against mechanical injury when using oxy-acetylene equipment. Extra cylinders of gas should be stored away from important locations and brought to the point of use as needed. Unless mounted on a portable truck, cylinders should be firmly chained to a post or wall to prevent falling and consequent damage of cylinders or reducer valves.

Production Welding

In locations used for permanent production welding, steps readily can be taken to prevent the sparks from being a source of danger by locating the work in fire-resistive buildings or in areas properly separated from other operations, with no combustible material in the vicinity.

Courtesy of Associated Factory Mutual Fire Insurance Companies

Permits place responsibility for welding and cutting operations and assure proper precautions by qualified personnel. This cut may be used as a printer's sample



PERMIT

FOR CUTTING AND WELDING WITH PORTABLE GAS OR ELECTRIC EQUIPMENTS

Date .....

Time Started ..... Finished .....

Building .....

Dept. ..... Floor .....

Location on Floor .....

Nature of Job .....

.....

Operator .....

ALL PRECAUTIONS HAVE BEEN TAKEN TO AVOID ANY POSSIBLE FIRE HAZARD, AND PERMISSION IS GIVEN FOR THIS WORK.

Signed .....
In Charge of Welding

Signed .....
Fire Chief

(SEE OVER)

INSTRUCTIONS TO OPERATORS

This permit is good only for the location and time shown. Return the permit when work is completed.

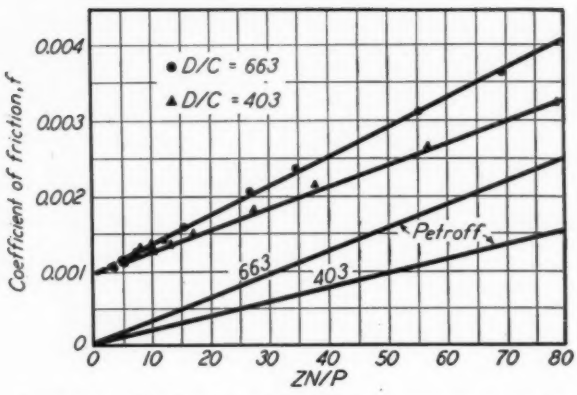
PRECAUTIONS AGAINST FIRE

1. Obtain a written permit before using portable cutting or welding equipment anywhere in the plant except in permanent safeguarded locations.
2. Make sure sprinklers are in service.
3. Before starting, sweep floors clean, wet down wooden floors, or cover them with sheet metal or equivalent. In outside work, don't let sparks enter doors or windows.
4. Move combustible material 35 feet away; cover what can't be moved with asbestos curtains or sheet metal, carefully and completely.
5. Station extra men with hose extinguishers, or fire pails to watch sparks and see that they do not start fire.
6. After completion, watch scene of work a half hour for smoldering fires, and inspect adjoining rooms and floors above and below.
7. Don't use the equipment near flammable liquids, or on closed tanks which have held flammable liquids or other combustibles. Remove inside deposits before working on ducts.
8. Keep cutting and welding equipment in good condition. Carefully follow manufacturer's instructions for its use and maintenance.

WHAT HAPPENS IN JOURNAL BEARINGS

Oil hole and groove arrangements in journal bearings gave a wide range of lubrication results during a National Bureau of Standards investigation. Data obtained will help solve lubrication problems.

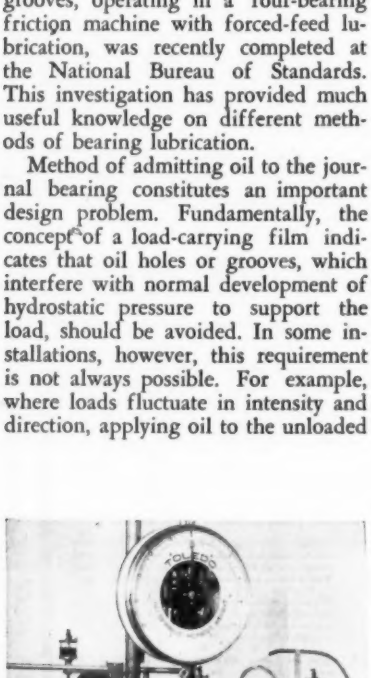
S. A. McKEE & H. S. WHITE
National Bureau of Standards



Coefficient of friction plotted against operating variable ZN/P provides friction data for one hole on unloaded side

COMPARATIVE performance of plain journal bearings having various arrangements of oil holes and grooves, operating in a four-bearing friction machine with forced-feed lubrication, was recently completed at the National Bureau of Standards. This investigation has provided much useful knowledge on different methods of bearing lubrication.

Method of admitting oil to the journal bearing constitutes an important design problem. Fundamentally, the concept of a load-carrying film indicates that oil holes or grooves, which interfere with normal development of hydrostatic pressure to support the load, should be avoided. In some installations, however, this requirement is not always possible. For example, where loads fluctuate in intensity and direction, applying oil to the unloaded side throughout the complete load cycle is sometimes impracticable. In other cases, provision must be made for a continuous oil flow to other parts.



Special four-bearing machine developed to study journal bearing performance

The Bureau's investigation covered five different arrangements for feeding oil through the bearing shell. These included one hole at the unloaded side center; two holes, one each on the loaded side; four holes, each 45 deg from the load line; one axial groove at the unloaded side center; and one circumferential groove.

Tests were also made with three arrangements for feeding oil from the center of a hollow shaft—that is, one and two shaft oil holes, and a one-oil-hole arrangement terminating in a flat extended along the shaft surface for one-half the bearing length. For all these arrangements each hole or groove was in the bearing axial center and was connected to the oil supply source.

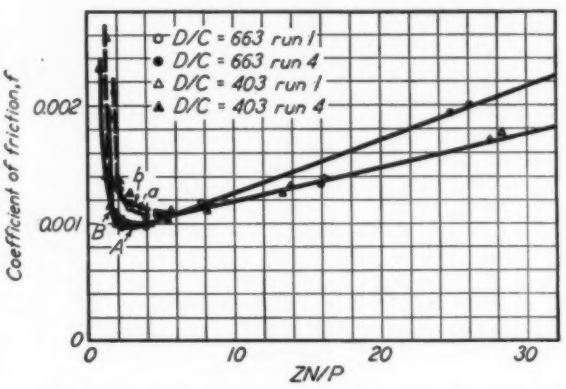
A four-bearing friction machine consisted essentially of four similar test bearings enclosed in a housing and mounted on a common shaft. The complete unit of bearings and housing acts as a cradle dynamometer. Loads are applied by hydraulic jacks, which form the housing base. Frictional torque is measured by a dynamometer scale acting through a torque arm fitted to the housing. An automatic device, provided in the hydraulic system, releases the load under high-torque conditions that occur near bearing seizure.

Test shafts were carburized steel, heat treated to hardnesses ranging from 55 to 61 Rockwell C and ground to a surface roughness ranging from 4 to 5 microinches. Solid steel sleeve test bearings with copper-lead linings were pressed into the bearing retainers, rough-bored in a lathe, assembled in the housing swivels and finished to size with a single cutting edge reamer.

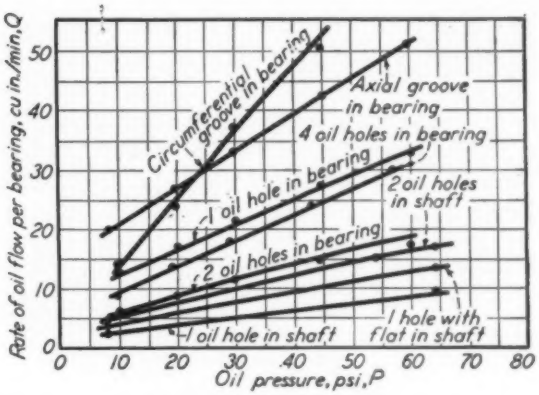
In order to obtain characteristic friction data with the minimum of change in bearing surface, tests were first made in the region of stable lubrication at the higher values of the generalized operating variable, ZN/P, where Z is the absolute lubricant viscosity, N shaft speed, and P pressure on the projected bearing area. Each test run was made at constant speed and load. These loads were successively increased at intervals.

After tests at high ZN/P, the range of operation was extended to cover low values of ZN/P at and below the point of minimum f. In each test speed and rate of oil flow were held constant, and the load was increased until unstable lubrication was reached. Under these operating conditions the bearings tend to change with continued running. Hence, four consecutive runs under a given set of conditions were made with each set of bearings tested.

Friction data were obtained in the first and fourth test runs with all bearing arrangements operating at 2030 rpm and with 15 cu in. per min oil flow. In these tests the bearings were operated at a given load for a period of two minutes and frictional torque observations were made at one-minute intervals. When operation was in the region of stable lubrication, the second torque reading was either equal to or lower than the first. As loads were increased, however, the bearings eventually reached an unstable operating condition where the second torque



Friction curves in unstable region with one hole on unloaded side. Curve A and a has a ratio of 663, curve B and b 403



Oil-flow versus oil-pressure curves for different feed arrangements. Q, flow rate is plotted against p, pressure

reading was higher than the first—namely, where the friction increased with an increase in temperature.

Data pertaining to thermal behavior were obtained in the tests at high ZN/P values under a steady state of temperature distribution. In analysis of these data consideration is given to the total heat supplied. Since oil-inlet temperature was higher than ambient, the rise was dependent upon heat generated by shearing the oil and that delivered by the oil entering the bearings. Thermal data obtained from all sets indicate that, under the conditions covered, heat-dissipation characteristics were dependent chiefly upon oil flow rate and were practically independent of clearance or type of hole or groove.

Measurements of oil flow rate at various oil-feed pressures were made when operating at a given load and speed. Since the rate of heat dissipation depended chiefly upon rate of oil flow, data obtained gave an indication of the relative heat-dissipation characteristics. However, these relative values are not necessarily applicable to other conditions.

Influence of various oil hole and groove arrangements upon bearing behavior is as follows:

One Oil Hole in Bearing. Absence of holes or grooves on the loaded side of the bearing permits normal development of oil film pressure. Consequently, the bearing has relatively low friction and low ZN/P at transition between stable and unstable lubrication. While the single hole does not allow the highest oil flow, it would probably provide adequate heat dissipation.

Two Oil Holes in Bearing. Single hole on loaded side disturbs the normal development of oil film pressure, causing a measurable increase in friction and ZN/P at the transition point. The particular oil hole location on the unloaded side is adverse from the standpoint of oil flow; hence rate of heat dissipation is somewhat lower than the arrangement with one hole in the bearing.

Axial Groove in Bearing. Arrangement apparently provides a slightly better distribution of oil for the development of the load-carrying film than the one hole bearing arrangement. Consequently, the bearing has low friction and lowest critical ZN/P. High oil flow is advantageous where forced cooling is necessary.

Four Holes in Bearing. Two holes on the loaded side disturb the development of oil film pressure to a greater extent than the arrangement with a two hole bearing. Critical ZN/P is higher, but the friction is comparable. Two holes on the unloaded side are not in advantageous positions. Oil flow and rate of heat dissipation are comparable to the one hole bearing.

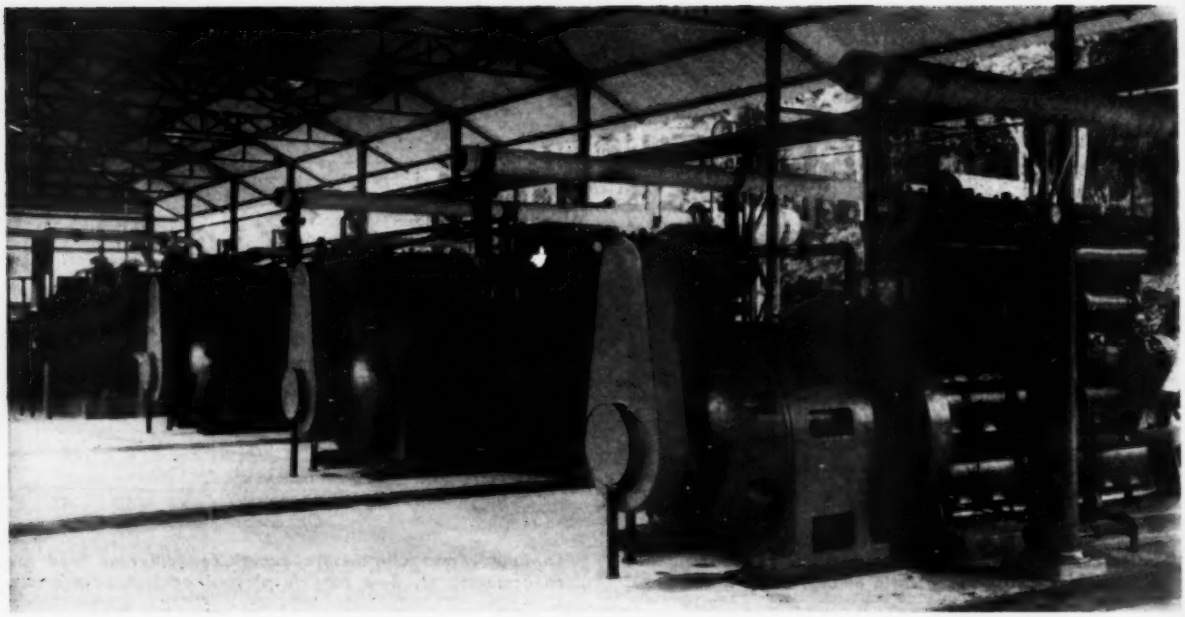
Circumferential Groove in Bearing. Groove dividing the bearing into two narrow parts increases friction and causes a relatively high critical ZN/P. High friction is counteracted by high oil flow and rate of heat dissipation.

One Oil Hole in Shaft. Passage of one oil hole across the loaded portion of the oil film has little effect on friction and critical ZN/P, which are only slightly higher than for the arrangement with a one hole bearing. When the hole is exposed to some loaded area portions, the oil feed is practically shut off. Consequently, this arrangement results in the lowest oil flow and rate heat dissipation.

Two Oil Holes in Shaft. With two oil holes for each journal, disturbance to film-pressure development occurs twice in a revolution. This results in slightly higher friction and critical ZN/P than with the arrangement of one hole in the shaft. The two holes also provide a greater oil flow and rate of heat dissipation. In this respect it is comparable to the arrangement with a two hole bearing.

One Oil Hole With Flat in Shaft. The flat at the end of the oil hole causes considerable disturbance to the development of oil film pressure, increases friction, and markedly increases critical value of ZN/P. Oil flow and rate of heat dissipation are higher than in the arrangement with one hole in the shaft without the flat but not sufficient to counteract the effect of high ZN/P at transition from stable to unstable lubrication.

Results of these tests apply to undirectionally loaded bearings for the particular range of conditions covered. Indicated differences between various arrangements are not necessarily indicative of more complex conditions where load varies in intensity and direction with respect to the bearings. However, the relative test values obtained may be useful qualitatively in estimating over-all effects of various hole or groove arrangements under more complex loading conditions, especially when proper consideration is given to conditions present throughout the complete load cycle.



Interior of central electric power generating station of Kern-Trinidad Oilfields, Ltd., Trinidad, B.W.I. These gas engines drive generators for entire installation using otherwise wasted natural gas from the fields. Open walls provide ventilation

WASTE GAS POWERS OIL FIELD

Using natural gas, ordinarily a waste product, this Trinidad company generates electrical power at extremely low cost for all plant demands

FUEL at practically no cost offers extremely cheap electrical power at the central generating station of Kern-Trinidad Oilfields, Ltd., Trinidad, British West Indies. Electric generators are driven by gas engines, which operate on natural gas supplied from oil wells in the southwestern part of Trinidad. This gas would ordinarily be a waste product.

Planned for durability and economy the plant is simple to operate, yet it is capable of giving satisfactory voltage and frequency regulation under complex and variable conditions. Power is furnished for oil well and water well pumping, machine shop operation, and domestic and power plant lighting.

Most serious complications occur at the oil wells. While the wells are not unusually deep, some of them turn to gas and unbalance the power system. Well load at the generating station may at times fluctuate rhythmically when peaks of the pumping cycle coincide.

Station equipment now includes three Superior 6G-510 six-cylinder gas engines. Each engine is direct-connected to a 720-rpm, 150-kw, 480-v, three-phase 60-cycle single bearing generator. Generator exciters are V-belt driven.

Speed Regulation

Even under rather difficult operating conditions, good regulation is insured, whether the units are operating singly or in parallel. An extra large diameter wrought-steel flywheel has been installed and a Woodward hydraulic relay-type governor controls operation on each engine. Fuel gas pressure is accurately regulated at the engine, and a voltage regulator controls the excitation of each generator.

Increase in flywheel effect is obtained by the large diameter and correspondingly high rim velocity, rather than by excessive weight. High bearing loads are thus avoided.

Current, generated at 480 v, is stepped up to 3300 v at the station and later transformed down to the required voltage at the various points of utilization. All lighting is at 110 v.

Each engine has a built-in jacket water circulating pump and an individual jacket water heat exchanger. A V-belt driven, raw water pump at each engine circulates cool water from a common atmospheric cooling tower sump through the engine's jacket water heat exchanger and returns it to the tower.

There is a shell-and-tube type lubricating oil cooler, through which jacket water circulates before it enters the engine jackets. During engine start up, the jacket water can warm the oil. As the engine warms up under load, the jacket water circulation cools the oil.

Each engine is equipped with large capacity, bypass-type lubricating oil filters. An exhaust silencer is located at the outer end of the horizontal exhaust pipe, which has flexible steel pipe connections to the engine manifolds.

Because this plant operates in a tropical climate, the upper part of the building's walls are of wire mesh to afford ample air circulation. Oil bath type intake air filters are therefore mounted directly on the engines.

HYDRAULIC SYSTEM KEPT LIKE NEW

Sunvis 916 Effects Substantial Savings; Strainers and Lines Kept Sludge-Free

A copper tubing manufacturer uses an oven with hydraulically operated doors to heat billets to approximately 1550F. The ambient temperatures around the hydraulic mechanism are abnormally high, putting the hydraulic fluid to a severe test of stability. Failure of the system would halt the piercing operation and result in costly delays throughout the plant.

Since the oven was first put in operation, three years ago, the hydraulic fluid has been Sunvis 916. The original charge has never been changed and is still in excellent condition, though the system is tight and requires only a minimum of make-up. Oil lines and strainers are completely free of sludge. Seals and packings are sound. Operations are never interrupted for oil changes or parts maintenance. The company expects to retain the original charge of Sunvis 916 in service indefinitely, effecting large savings in both oil and maintenance costs.

Sunvis 916 is a solvent-refined oil of the highest quality. It is fortified to resist the oxidation and sludging so detrimental to the efficient operation of hydraulic systems. Sunvis 900 Oils are *good for the life of your machines*. For your copy of the illustrated booklet "Sunvis 900 Oils" write Department IP-10.

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Spot News

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants.

Splashproof Motors Tested For All-Weather Installations

Electric drives for power plant auxiliaries, including pumps, fans, etc., which are to be located out-of-doors, naturally must be protected against the entrance of water or moisture into the windings or bearings. For more than five years, the Elliott Co., Jeannette, Pa., has been working on the development of splashproof motors for installation outdoors.

The picture shown here was taken during the demonstration and test conducted recently for utility executives interested in outdoor motor application.

A vertical and a horizontal motor of the new splashproof design were mounted on a railroad flatcar and high-pressure water was directed at the motors through plant fire hoses equipped with special, adjustable nozzles which could provide any desired flow from stream to mist. The test was continued for several hours with motors operating at 2,300 v, and with water pointed at the motors from every angle.

At the end of the test, the motors were completely disassembled. A study of the internal windings showed that no moisture had found its way inside. The specially-designed conduit boxes used on these motors were also examined and found to be completely dry.

Atomic Energy Commission Will Establish New Production Plant

The United States Atomic Energy Commission has selected E. I. du Pont de Nemours and Co., Inc. as contractor for the design, construction and operation of new production facilities which will be located at a site yet to be determined. The du Pont company has already started preliminary work and has agreed to continue the project, providing mutually satisfactory contract conditions can be worked out with the Commission.

The additional plants, like existing facilities, will provide materials which can be used either for weapons or for fuels potentially useful for power purposes.

The commission is also establishing a new operations office, its ninth major field installation, to supervise the new facility's site selection, design, construction and operation. Temporary headquarters for the office are in Washington, D. C., with Curtis A. Nelson designated as manager.

Two and Quarter Million Dollar Laboratory for Ponca City

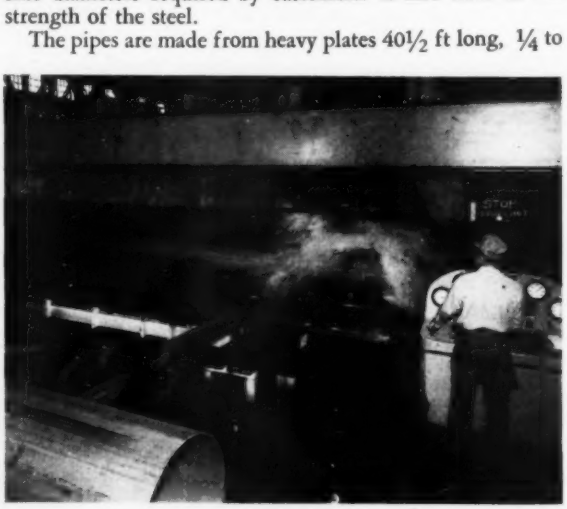
The Continental Oil Co. has awarded Wigton-Abbott Corp., engineers and contractors of Plainfield, N. J., the contract for design and construction of a $2,250,000 air-conditioned laboratory building at its Ponca City, Okla., plant.

The new, three-story building of reinforced concrete will feature an unusual arrangement of completely concealed air-conditioning duct work and laboratory utility lines in common chases. A monitor roof will contain utility space for the air-conditioning equipment and some of the large laboratory apparatus, including stills, vacuum pumps and a de-ionizer.

Steel Pipes Stretched by Water Under High Pressure

Water confined under pressure has been harnessed for a new use at the new Electric Weld Pipe mill of U. S. Steel's National Tube Co., McKeesport, Pa. There, water under 3,000 psi is used to expand the diameter of big pipes. This process makes it possible to produce pipes to the exact outside diameters required by customers. It also adds to the strength of the steel.

The pipes are made from heavy plates 40½ ft long, ¼ to



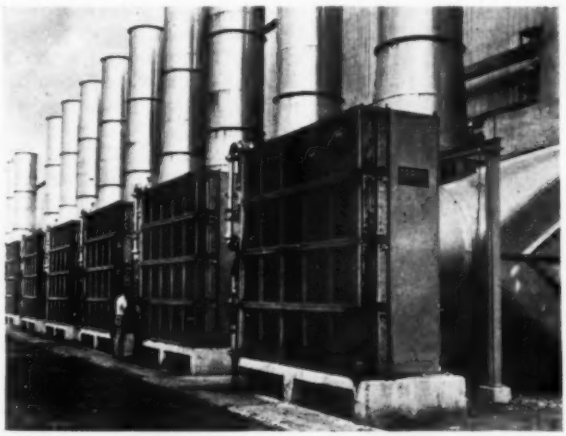
½ in. thick and 79½ to 110½ in. wide. Special processes round the plates into tubes and the seam is welded inside and out. Tubes are inspected and passed to the expander.

This machine is equipped with a fixed plug on one end and a movable ram on the other. Both ram and plug are tapered and fitted to insure water-tight connections when the pipe is in place. Pressure on the ram forces the tapered fittings into the pipe, swelling the ends into a bell shape. Locked in place around the pipe is a die, machined to limit the stretch to the exact diameter specified by the customer.

Three pumps force water into the pipe from a 25,000 gal reservoir. The thickness of the steel in the pipe walls determines the pressure needed. As the pipe enlarges in diameter, it is reduced in length and the ram automatically advances to maintain a tight seal on the retreating ends of the pipe. When the tube is tight within the die, water pressure is reduced, the dies are opened and the pipe is tested and finished.

Battery of Water and Oil Coolers Aids Alcoa's Diesel Engines

Three-block-long bank of 120 radiators gives a rough idea of the huge cooling system built for the internal combustion power plant of the Aluminum Company of America at Port Lavaca, Texas (INDUSTRY and POWER July pp 84). These units were built by The Trane Co.



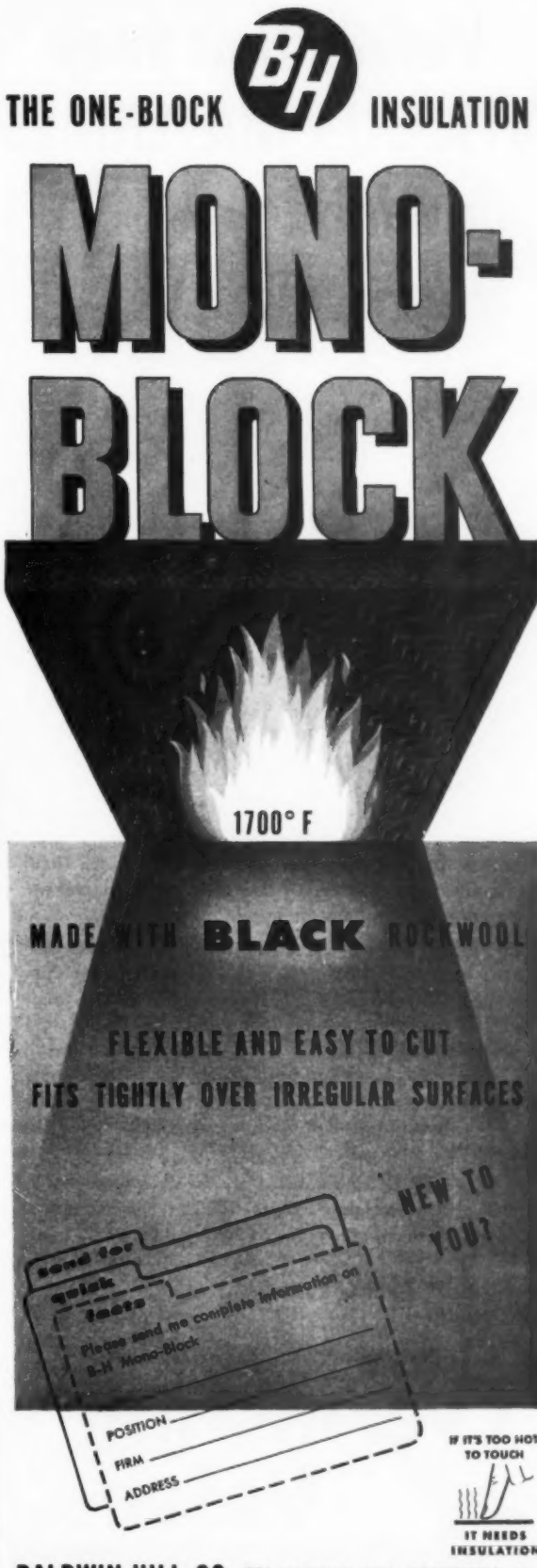
Scarcity of suitable cooling water at Port Lavaca made necessary the installation of a closed water cooling system. Heart of this system is the bank of 120 giant aluminum fluid coolers. Each cooler has a cooling coil, fan and casing that stands 11½ ft high, 13 ft long and 9 ft deep. A six bladed propeller fan has a diameter of seven feet. The units are made up of four cooling coils with separate cores for cooling engine jacket water and lubricating oil. Air is discharged into aluminum stacks, which also discharge engine exhaust gases and generator cooling air.

The coolers were fabricated almost entirely from aluminum. Tubes were expanded to make a good bond between cooling fins. Over a half million pounds of aluminum tubing, sheets and strips were required.

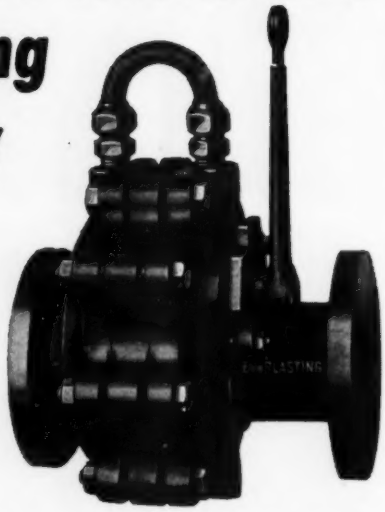
Bids Open for Three Generating Units at Hoover Dam

The Bureau of Reclamation has invited bids on a major contract involving the first installations of equipment for generating units A-3, A-4, and A-9 in the Arizona wing of the Hoover power plant, E. A. Moritz, director of the Bureau's Region 3 announced.

The contract will call for the installation of two 115,000-



Valves that keep VISCOUS MATERIALS flowing freely



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hp and one 70,000-hp hydraulic turbines with pressure regulators and governors for two 82,000-kva and one 60,000-kva generating units. The generators, now being built, will be installed by their manufacturers during 1951 and early 1952.

Units A-9 and A-4 are scheduled to go on the line in November 1951, A-3 will follow in January 1952. The three units will complete the installation of the Hoover power plant's Arizona wing, raising the plant's capacity to 1,249,800 kw. Installation of an 82,500-kw unit, yet to be ordered, will complete the plant's installation of fifteen such units and two smaller units, bringing the plant's capacity to 1,332,300 kw.

Units A-3 and A-4 are being installed at the request of the Arizona Power Authority, representing the State of Arizona. Unit A-9 is being installed at the request of the Colorado River Commission of Nevada, representing that State.

Philadelphia Electric Co. Orders World's Largest Steam-Electric Generator

The Westinghouse Electric Corp. has received a contract for a 125,000-kw generator to be installed in the Delaware station of the Philadelphia Electric Co. This will be the largest of its particular type ever built by the company and the largest yet to be installed in this country.

A new insulation, called Thermalastic, will be used in the generator. This insulation consists of mica flakes embedded in tough, heat-resistant, synthetic resin with sufficient stretch at operating temperatures to expand and contract with the generator coils. Tests indicate that this new insulation has a life at least ten times as great as previous insulations, according to company announcements.

The "two-pole" machine will operate at 3,600 rpm. Hydrogen gas will serve as a coolant for the generator with the

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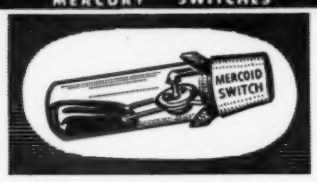

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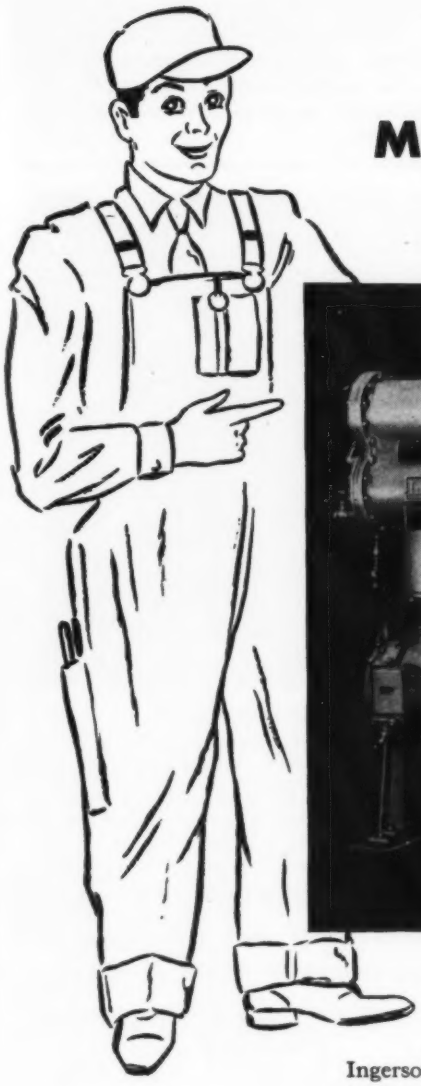
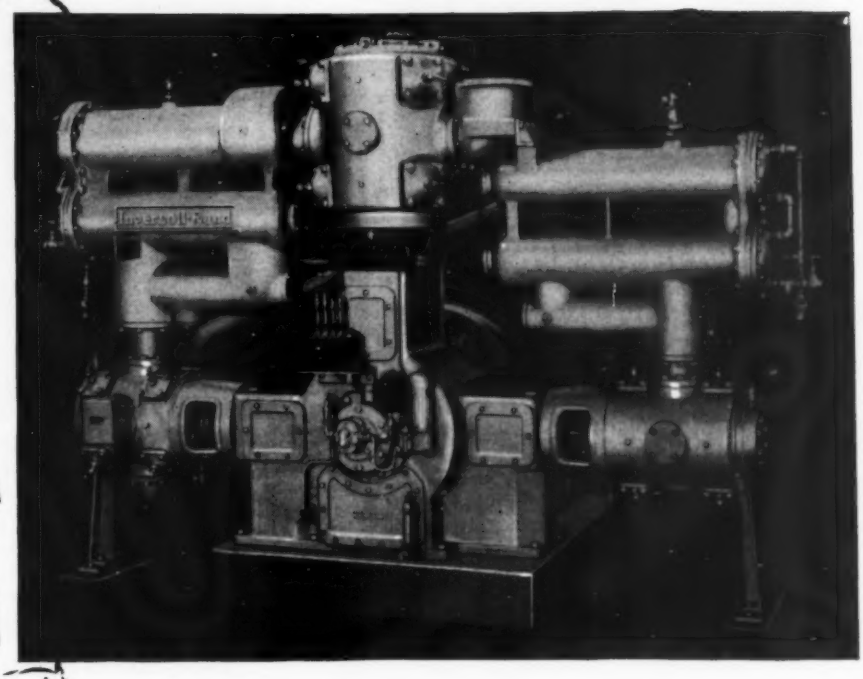


MASTER OF MANY TRADES



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Ingersoll-Rand's 3-stage TVH Heavy-duty Compressors are widely used for boiler soot-blowing service, for handling gases where leakage must be avoided, for compressing air in oxygen production, and in scores of other applications. They're compact, highly efficient, give long-life heavy-duty service. The two main bearings are SKF Double-Row Self-Aligning Spherical Roller Bearings. They require no adjustment . . . are engineered and built to withstand heavy radial and thrust loads. SKF specializes in supplying the bearing that's right for the job . . . the bearing that keeps friction at a minimum and makes important contributions to long-term trouble-free operation. SKF Engineers will work with you in helping you design for greater efficiency and lower operating costs. **SKF** INDUSTRIES, INC., PHILADELPHIA 32, PA., *the Pioneers of the Deep Groove Ball Bearing – Spherical Roller Bearing – Self-Aligning Ball Bearing.*

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SKF

BALL AND ROLLER BEARINGS

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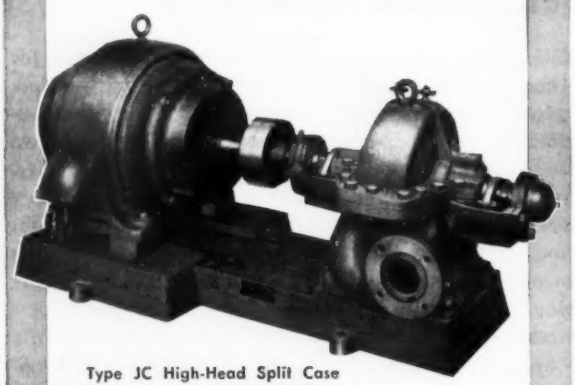
Unless your pumping installation incorporates the right basic design, you're pumping away money. The outstanding feature of WEINMAN Centrifugal pumps is the soundness of their basic design. WEINMAN engineered features make these pumps perform most efficiently . . . dependably . . . economically. The men responsible for these designs specialize in one product — Centrifugal pumps but their knowledge covers and benefits all industries, yours included.

You may be surprised to learn what the *right* basic design can do for your present pumping operations. A nearby WEINMAN representative can give you facts and figures. Contact him by mail, wire or phone TODAY!



Type JC High-Head Split Case Pump . . . two stage, back to back, impeller design . . . Capacity up to 600 G.P.M., Heads to 600 feet.

Representatives in Principal Cities

Built by Centrifugal Specialists

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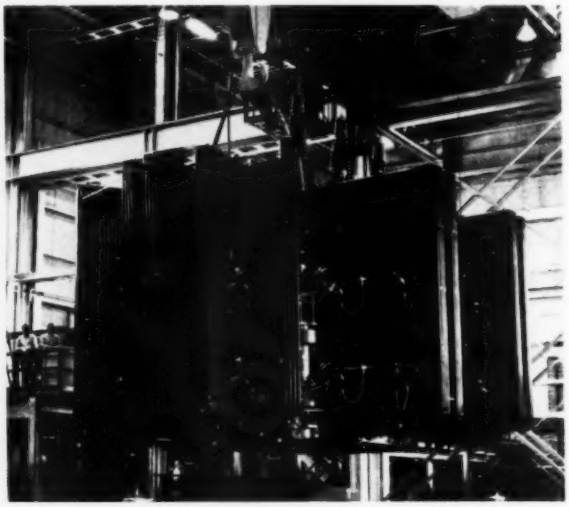
housing being designed and tested to withstand 30 psi internal pressure; normal operating pressure will be ½ psi.

The steam turbine which will drive the huge generator will be built at the South Philadelphia Steam Div. of the company. The new turbine generator unit is scheduled for delivery to Philadelphia in 1952.



TESTING GIANT TRANSFORMER

Giant transformer, largest in physical size ever built by General Electric, is hoisted from test pit by 250-ton crane, prior to shipment by drop-frame car to the Union Electric Co. of Missouri. Rated 100,000 kva, the three-phase, fan-cooled transformer is designed to operate at 138,000 volts

New *VERSENE test kit determines total water hardness in less than *TWO MINUTES***

Now, with this new Versene* water hardness testing kit you can determine the hardness of your own boiler, process or tap water as easy as ABC—in less than 2 minutes. Anyone who can tell red from blue can make this scientific versenate test and be accurate within one grain of hardness per gallon.

Handy, sturdy, pocket-size plastic kit contains 3 vials of chemicals and one combination measuring and mixing vial. More than 50 separate tests can be made, depending on water hardness. Complete instructions. Refills available.

Order The New Versene* Water Hardness Testing Kit today. $5.00 Postpaid. Send Checks or M.O. No C.O.D.'s. Money Back Guarantee.

We also manufacture and supply Inhibited Indicator and Di Sodium Versenate (the di sodium salt of ethylene diamine tetra-acetic acid). These are the reagents used in the Versenate (Schwartzenbach) Method for the determination of Water Hardness.

Di Sodium Versenate
50 g. $2.00 100 g. $3.00 500 g. $10.00

Inhibited Indicator
100 cc $1.00 250 cc $2.00 500 cc $3.00 1000 cc $5.00

BERSWORTH CHEMICAL COMPANY
FRAMINGHAM, MASSACHUSETTS

*Trade Mark

"Cold Rubber" Adapted to Conveyer and Elevator Belts

Use of "cold rubber" in some of the conveyer and elevator belts which it manufactures has been announced by the B. F. Goodrich Co., Akron, O. Methods have been found, the company says, to use the good qualities of the improved, general-purpose, man-made rubber, particularly its higher resistance to abrasion, in certain flat belt services.

"Cold rubber" when properly compounded for use in conveyer and elevator belts should add from 10 to 25% more wear in certain services, the company declares.

This type man-made rubber gets its popular designation as "cold rubber" because it is made at a temperature of 41 F, while the older type general purpose rubber is created at a temperature of 122 F. The rubber is being produced in large amounts in rubber plants of the government, including one at Port Neches, Tex., operated by Goodrich.

Alcoa Develops New Aluminum Cable Sheathing

Applying a seamless sheathing of aluminum to telephone and electric power cables has been developed by Alcoa. This new method involves the principle of cold reduction or swaging.

Seamless aluminum sheathing for cable is thinner, stronger and lighter in weight than the usual lead sheathing. These advantages are possible because aluminum has about one-fourth the density of lead, and with higher yield and tensile strengths it can be applied in approximately one-half the thickness. Consequently, one foot of the new sheathing

(Continued on page 141)

HAJOCA CORPORATION

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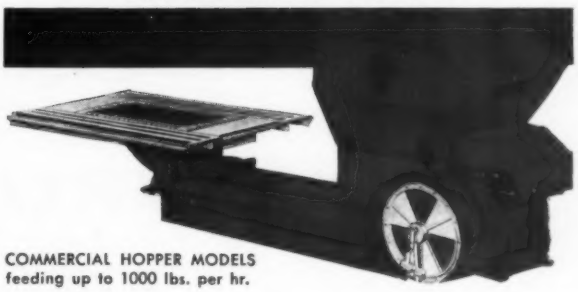
GENERAL OFFICES, 31st & WALNUT STS., PHILADELPHIA 4, PA.

Combustioneer

FOR HIGHER HEAT EFFICIENCY AT LOWER COSTS



COMMERCIAL HOPPER MODELS
feeding up to 1000 lbs. per hr.

Factories, plants, shops, stores, theaters, hotels, apartment houses, other large private and public buildings . . . all use *big quantities* of heat, hot water or steam . . . all can show *staggering fuel costs!*

Yet you can cut those costs . . . cut them up to 30% . . . with Combustioneer Automatic Coal Stokers. Think of that saving . . . monthly . . . or *yearly!*

Combustioneer gets *all* the heat *out* of the coal. Its exclusive "Pulsating" Transmission, Automatic Respirator and "Breathing" Fire-Bed assure highest efficiency combustion under all conditions and provide perfectly controlled automatic heat. And Combustioneer's extremely rugged design and construction pay off in long-lived dependability and lowest maintenance cost.

Hopper and bin-feed models, capacities up to 1000 lbs. per hr. Write us today for further information about how Combustioneer is saving money in your specific kind of business and can save money for *you.*

THE STEEL PRODUCTS ENGINEERING CO.
1235 W. Columbia St., Springfield, Ohio

Please send us, without obligation, further information about your commercial models of Combustioneer, and information about your free heating analysis.

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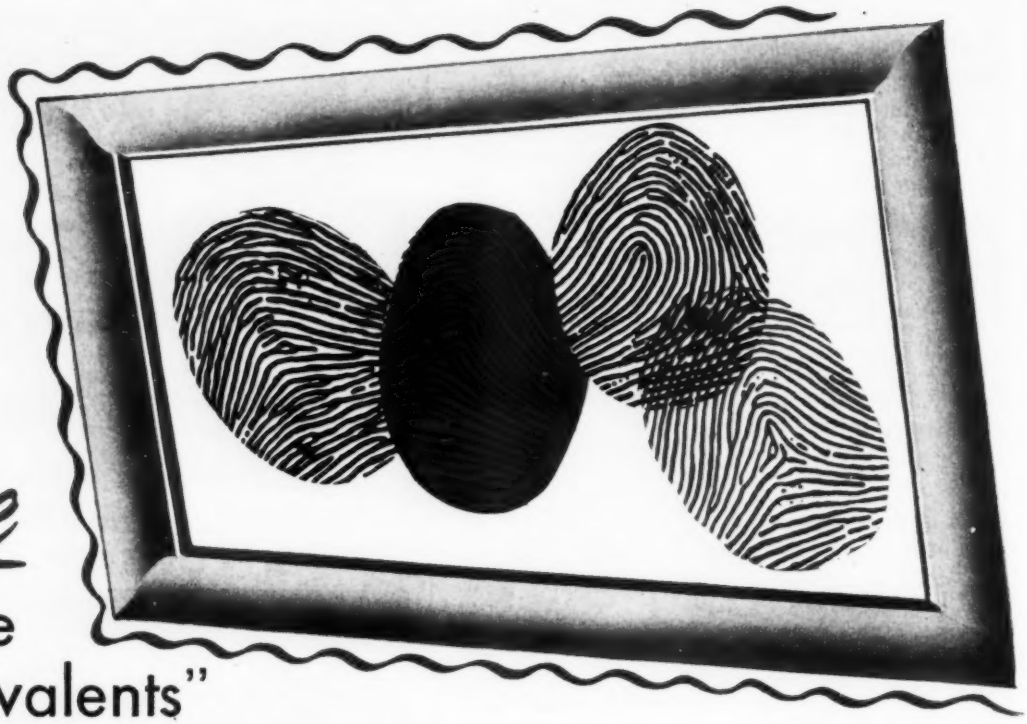
KIND OF BUSINESS_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____



are there "equivalents" to **LUNKENHEIMER** STEEL VALVES?

Well, there are "alternates." But the engineer's familiar specification, "Lunkenheimer Figure 1938 or equivalent," invites a comparison with your thumbprint — and your neighbor's. How "equal" can valves really be? A few characteristics can *almost* be matched. But there is no equal for most Lunkenheimer features. Consider the metal quality of Lunkenheimer steel castings. Their soundness is unparalleled in the valve field. Lunkenheimer metallurgical research has uncovered whole new areas of study, developed exclusive alloys, pioneered in methods of quality control. The amazing records of safety and long service life achieved by Lunkenheimer steel valves are evidence that there *is* no real equivalent for Lunkenheimer metal quality. In workmanship, too, the famous Lunkenheimer tradition of care and precision has never been equalled. New machines (most of Lunkenheimer's machinery is less than three years old) are making possible *even higher* standards of workmanship. The *only* equivalent to a Lunkenheimer steel valve is another of the same design —a Lunkenheimer. For the address of your nearest representative, and for more steel valve data, write to The Lunkenheimer Co., P. O. Box 360B, Cincinnati 14, Ohio.

STEEL . . . IRON . . . BRONZE

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-950-9 X

Plant Engineer's Handbook

COMPILED BY GENE FELLER

HOW TO SPACE PIPE SUPPORTS

WHEN a horizontal pipeline is supported at intermediate points, sagging of the pipe may occur between supports. Amount of sag depends on the weight of the pipe and fluid, plus any insulation, valves or fittings in the line.

If the pipe is installed with no downward pitch, pockets may form in each span. In lines conveying steam, condensate may collect in these pockets. To eliminate them, the line should be pitched downward so the outlet of each span is lower than the maximum sag.

Tests were conducted to determine the deflection of horizontal standard lines filled with water, in pipe sizes ¾ to 4 in. inclusive. The results indicate that, for pipe larger than two inch with supports having center to center dimensions greater than ten feet, the resultant deflection is less than that determined by the use of the equation for a uniformly loaded pipe fixed at both ends.

For pipes two inch and smaller, the test deflection was in excess of that determined by the equation for a pipe having fixed ends. For the shorter spans, it approached the deflection as determined by the use of the equation for pipelines having unrestrained ends.

The chart on the next page gives the deflection, for varying spans, of horizontal standard pipelines filled with water. It is based upon results obtained from tests for pipe sizes two inch and smaller, and upon the equation for fixed ends for the larger sizes of pipe. The deflection values given on the chart are twice those obtained from tests or calculations.

The equation that follows indicates the vertical distance that the span must be pitched so the outlet is lower than the maximum sag of the pipe:

$$h = \frac{144\ S^2\ y}{36\ S^3 - y^2}$$

Where:
h = difference in elevation of span ends, inches
S = length of one span, feet
y = deflection of one span, inches

By eliminating the inconsequential term ($-y^2$) from the denominator, the equation reduces to:

$$h = 4y$$

The pitch of pipe spans, called the average gradient, is a ratio between the drop in elevation and the length of the span. This is expressed as so many inches in a certain number of feet:

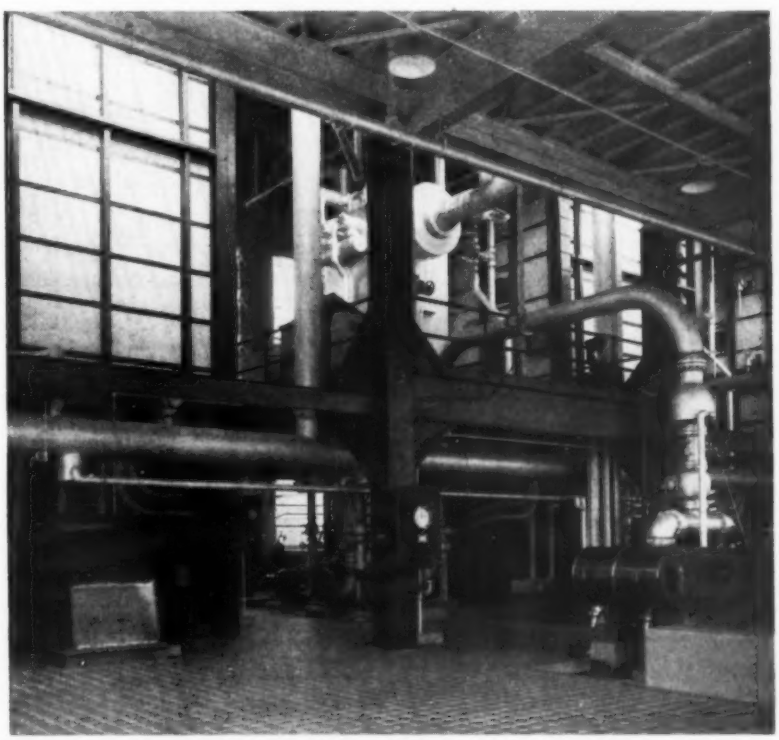
$$\text{Average gradient} = \frac{4y}{S}$$

Dotted lines shown on the chart are plotted from the above equation and indicate average gradients.

Typical Problem. What is the maximum permissible distance between supports for a four-inch standard pipeline, assuming a desired pitch or average gradient of one inch in thirty feet?

Solution. Proceed downward from the intersection of the diagonal dotted line for an average gradient of 1 in. in 30 ft and the diagonal solid line for 4-in. pipe. At the bottom line it is noted that the maximum span is about 22 ft.

Courtesy of Crane Co.



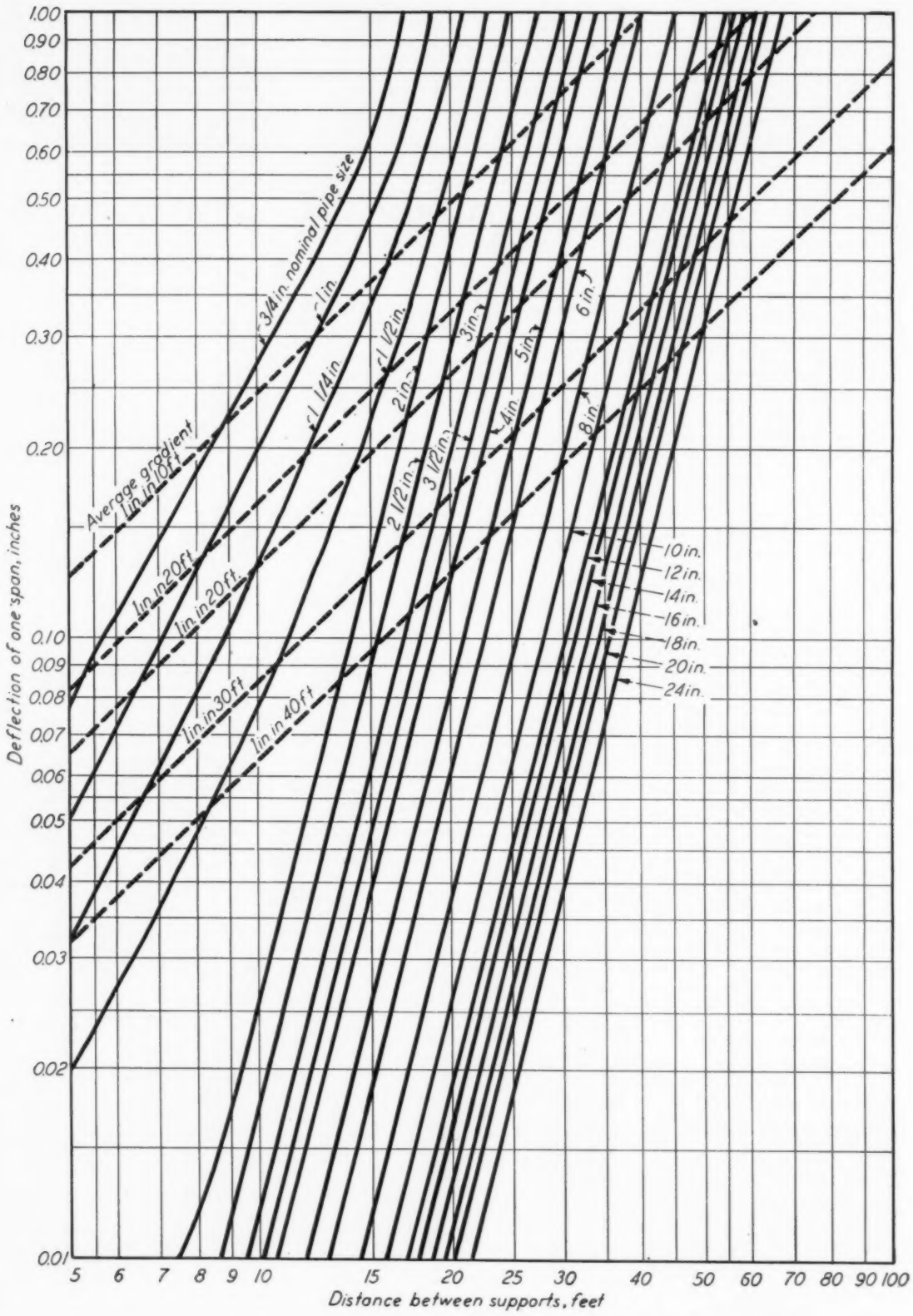
Pipe hangers must be spaced close enough to support the total expected load of piping and contents and covering. Supports must be designed to permit pipe expansion.

ENGINEERING DATA

This department is devoted to engineering data that plant engineers can use in their design and installation work. If you have a curve, chart or other data you find useful, let us publish it. Rate of pay will be based on the engineering value of contributions, with a minimum of $15 for smaller-than-page items accepted.

DEFLECTION OF HORIZONTAL PIPELINES

(Based on Standard Pipe Filled With Water.)



MEETINGS

OCTOBER

National Academy of Sciences—The National Academy of Sciences will hold its autumn meeting at the recently completed quarters of the General Electric Research Laboratory near Schenectady, N. Y. According to Dr. A. N. Richards, President of the Academy, the meeting will begin on Monday afternoon, Oct. 9.

Instrumentation for the Process Industries—Fifth annual symposium to be held at the Agricultural and Mechanical College of Texas, at College Station, Tex., October 11, 12, and 13. Course will be conducted as a seminar with lectures and discussions on the subject of automatic control. Professor P. G. Murdock, Chemical Engineering Dept., Texas A&M College, College Station, Tex.

National Safety Congress—The 38th National Safety Congress and Exposition will be held Oct. 16 to 20 in Chicago, Ill. Sessions on industrial safety are scheduled at the Stevens, Congress and Morrison Hotels, and traffic safety sessions at the Congress. R. L. Forney, general secretary, National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

Water Conference—The Eleventh Annual Water Conference, sponsored by the Engineers' Society of Western Pennsylvania will be held at Hotel William Penn., Pittsburgh, Pa., Oct. 16-18.

American Institute of Electrical Engineers—The fall meeting of the American Institute of Electrical Engineers will be held Oct. 23 to 27 in the Skervin Hotel, Oklahoma City, Okla.

Materials Handling Conference—Third biennial meeting will be sponsored by Westinghouse Electric Corp. Buffalo, N. Y., on October 24 and 25. First day's session will be held in the Hotel Statler; second day's program at Westinghouse Buffalo plant. Write R. A. Duffus, Technical Press Service, Westinghouse Electric Corp., 306 Fourth Ave., Pittsburgh 30, Pa.

American Welding Society—The 31st annual meeting is scheduled for the week of October 23rd at the Hotel Sherman in Chicago. Sessions will be held in conjunction with the American Society of Metals' annual meeting. For further information write: American Welding Society, 33 West Thirty-Ninth St., New York 18, N. Y.

NOVEMBER

Industrial Management Conference—A program of panels, displays, seminars and addresses by management leaders will feature the fourth annual University of Missouri Industrial Management Conference to be held at Columbia, Mo., November 2 to 4. The conference is sponsored by Associated Industries of Missouri, Society for Advancement of Management, Industrial Council of

Where You'll Find Proof Of The Experience Behind . . .

BOILERS BY BIGELOW

Some Typical Installations of Boilers By Bigelow

THE STANLEY WORKS, New Britain, Conn.
50,000 lb. per hour . . . oil fired

A. G. SPALDING & BROS., INC., Chicopee, Mass
40,000 lb. per hour . . . oil

STANFORD UNIVERSITY, Palo Alto, Calif.
40,000 lb. per hour . . . oil & gas

ST. MARY'S SUGAR, Sorel, La.
45,000 lb. per hour . . . bagasse

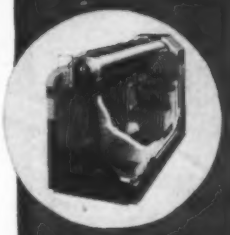
BARTGIS BROTHERS, Ilchester, Md.
60,000 lb. per hour . . . coal

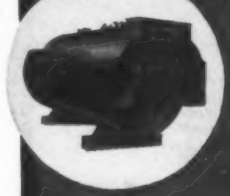
GENERAL E. L. LOGAN AIRPORT, E. Boston, Mass.
65,000 lb. per hour . . . oil

CHINA AMERICAN PAPER CO., Shanghai, China
20,000 lb. per hour . . . oil

INTERNATIONAL SILVER CO., Wallingford, Conn.
30,000 lb. per hour . . . oil

PETER PAUL, INC., Philippine Islands
12,000 lb. per hour . . . coconut husks





Throughout industry, Bigelow boilers are piling up service records of efficient steam production. Each successful installation is further evidence of Bigelow's boiler-making experience. Each is operating proof of Bigelow's ability to build boilers to answer a wide range of steam requirements.

Every one of the hundreds of Bigelow boilers holding down vital power jobs is another reason for you to consider Boilers By Bigelow for your plant.

Write for free catalogs on any of the units listed here.

BOILERS BY BIGELOW
Water Tube Boilers — Bent Tube Types
Horizontal Return Tubular Boilers
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Huge Rotary Kiln in the Jacksonville, Florida, paper mill of the **NATIONAL CONTAINER CORPORATION**

they say:

"We use This Lubricant on big, hot, heavy bearings and like it!"

Following is an extract from a lubrication report made by the plant engineer at the Jacksonville, Florida, Plant.

7' diameter by 300' long lime kiln, supported by five sets of trunnion rollers.

Temperature inside kiln at hot end is approximately 1800° F.

Kiln turns at approximately 1 RPM, trunnions turn at approximately 3 RPM on 7" journals in sleeve bearings lubricated by LUBRIPLATE No. 8.

Since changing to LUBRIPLATE No. 8 two years ago, wear on all bearings and journals has been reduced to a minimum, where formerly a definite problem of lubrication existed.

It is in these unusually severe applications where LUBRIPLATE LUBRICANTS dramatically prove their outstanding qualities. Probably more seemingly impossible lubrication conditions have been satisfactorily met with LUBRIPLATE in the past twenty years than by any other group of lubricants.

In most instances, LUBRIPLATE Lubricants have been introduced to solve a difficult lubrication problem. Their performance is so remarkable that their use is extended throughout the plant. They definitely reduce friction and wear, prevent rust and corrosion and save power.

LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases . . . a product for every lubrication requirement. Let us send you case histories of their use and savings in your industry. Write today.

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Fiske Brothers Refining Company
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DEALERS EVERYWHERE—CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE

THE MODERN LUBRICANT

Kansas City, and the Industrial Relations Club of St. Louis. Robert C. Manhart, professor of Business Management is chairman of the conference.

National Power Exposition and ASME Meeting—The 19th National Exposition of Power and Mechanical Engineering will be held in Grand Central Palace, New, York, November 27th to December 2nd under the auspices of the ASME in conjunction with the Society's annual meeting.

Complete information may be secured from Charles F. Roth, Grand Central Palace, New York 17, N. Y.

JANUARY

Plant Maintenance Show—and concurrent conference on maintenance techniques will be held in Cleveland, January 15 to 18. Clapp & Poliak, Inc., 341 Madison Ave., New York City 17.

Heating and Ventilating Exposition—The Tenth International Heating and Ventilating Exposition, also known as the Air Conditioning Exposition, will be held at the Commercial Museum in Philadelphia, Pa., January 22 to 26, 1951. The display will be under the auspices of the ASH&VE whose 57th annual meeting will coincide with the exposition. The exposition is under the management of the International Exposition Company, 480 Lexington Ave., New York, Charles F. Roth manager.

BOOK REVIEWS

Building Codes

"Basic Building Code," and "Abridged Building Code," prepared by the Building Officials Conference of America, Inc. Published by the Building Officials Foundation, 51 East 42nd Street, New York 17, N. Y. Basic Building Code, $5.00 (paper) and $6.50 (cloth). Abridged Building Code, $3.00 (paper) and $4.50 (cloth).

These performance type building codes contain information principally residential in character and include the usual civic, commercial and educational buildings essential to community life. The Building Officials Conference of America, Inc. has spent five years in creating the comprehensive Basic Building Code and the 118-page Abridged Building Code. The National Association of Home Builders supported the project, and its Building Code Committee worked with building officials.

Aside from the code's suitability for adoption in all parts of the country, its most striking feature is performance requirements rather than detail specifications.

All recognized standards of construction and specifications of material of authoritative technical agencies are accepted. Traditional materials and methods of construction are accredited including steel, wood and concrete, and the building official can approve all new techniques and materials that meet specified standards of performance.

It's easier with HYATT HY-LOADS

IN ADDITION to the "A-TS" bearing illustrated there are nine other major types of Hyatt Hy-Load Roller Bearings. Four have separable inner races, two have separable outer races and four are non-separable thus giving a designer a wide choice of bearings which permits flexibility in machine design and assembly procedures.

The "A-TS", one of the separable inner race type, is a high capacity cylindrical roller bearing made in two diameter series, wide and narrow widths, to standard AFBMA boundary dimensions.

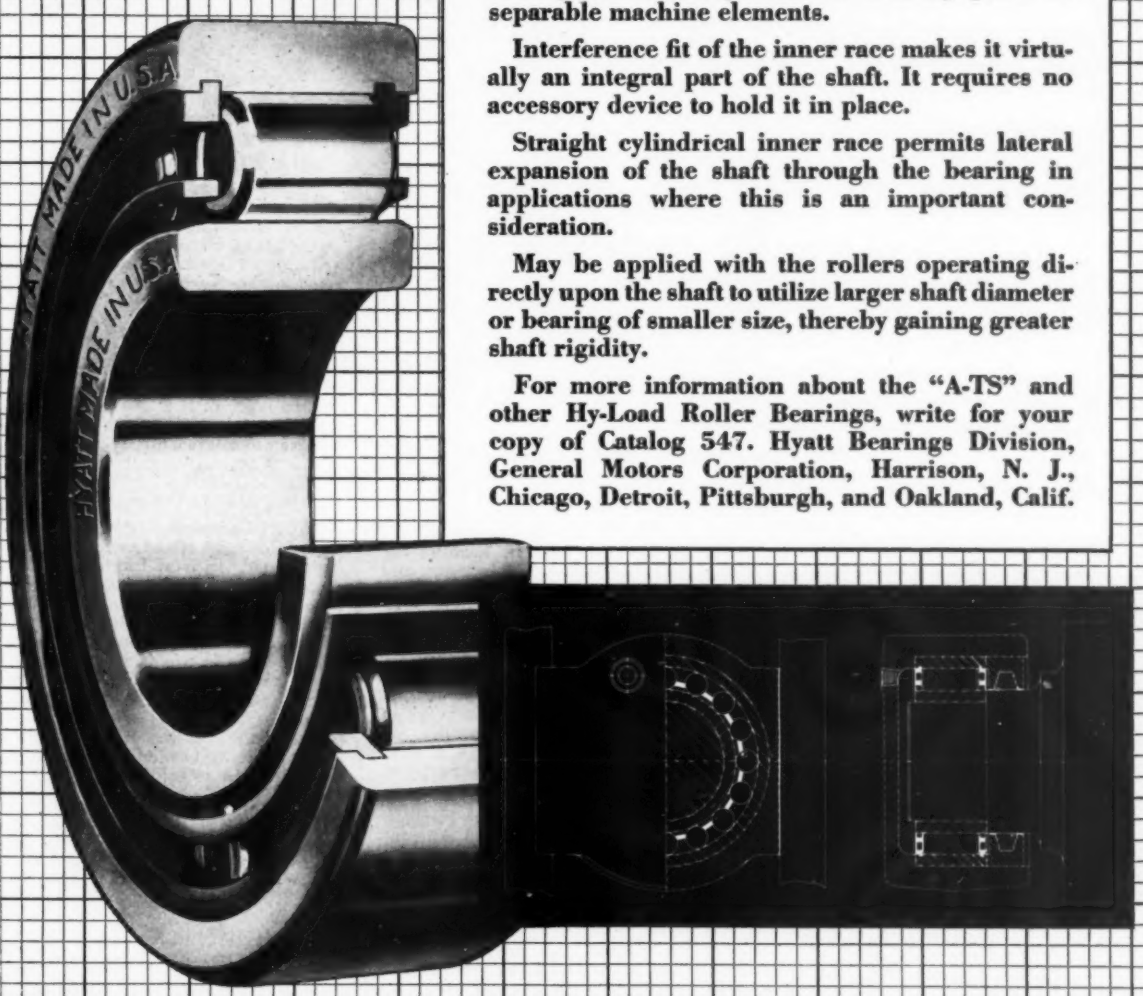
Separable parts are freely interchangeable. Any inner race will fit any roller assembly of the same piece number. This permits non-selective fitting after pre-assembling the two bearing parts in separable machine elements.

Interference fit of the inner race makes it virtually an integral part of the shaft. It requires no accessory device to hold it in place.

Straight cylindrical inner race permits lateral expansion of the shaft through the bearing in applications where this is an important consideration.

May be applied with the rollers operating directly upon the shaft to utilize larger shaft diameter or bearing of smaller size, thereby gaining greater shaft rigidity.

For more information about the "A-TS" and other Hy-Load Roller Bearings, write for your copy of Catalog 547. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Chicago, Detroit, Pittsburgh, and Oakland, Calif.



HYATT ROLLER BEARINGS

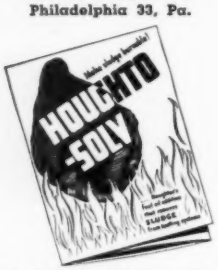
More than a
HALF-BILLION
gallons of
fuel oil
have been treated
with
HOUGHTO-SOLV
to remove sludge

. . . and in each case users gain not only higher heating efficiency but also sizable savings *in hard cash!*

Messy, laborious sludge cleaning jobs have been eliminated . . . for example, nearly $2,000 was saved in just one instance by the application of Houghto-Solv.

This industrial fuel oil additive dissolves *all* the sludge in your entire system. It cleans tanks, lines, strainers, pumps, nozzles, etc. Simply add one quart per 1,000 gallons of fuel oil. Results come quick!

E. F. Houghton & Co.
303 W. Lehigh Ave.
Philadelphia 33, Pa.



This free folder is helpful
Write, or call the Houghton Man, for this descriptive folder which gives complete data on this speedy fuel oil solvent.

NEWS . . . of men and companies

National Supply Co.—The Atlas Imperial Diesel Engine Co., of Oakland, Calif., was purchased last month by this Pittsburgh manufacturer and distributor of oil field machinery and equipment. The manufacture of Atlas Imperial diesel engines and parts will be carried on in the new owner's Springfield, O., plant where the company has been building Superior Diesels and other engines.

United Centrifugal Pumps Div. United Iron Works—A new regional office in Houston, Tex., was opened September 1. The new manager is Halley Johnston, who will act in an advisory capacity over the Houston, Tulsa, St. Louis and Denver district offices.

Ward Leonard Electric Co.—James E. Reagan is taking over new duties as assistant manager in charge of sales promotion and advertising. He joined the company in 1937 as sales engineer and has been editor of the company's house organ since 1945.

Enterprise Engine & Machinery Co.—Wren Malone became a member of the Chicago branch sales staff August first. He will serve the company in the Illinois, Ohio, Indiana, Michigan, and Wisconsin areas, where he has been a familiar figure in diesel engine circles for the past five years through his previous position as regional manager of the Superior Engine Div. of the National Supply Company's Springfield, Ohio, branch.

Fred H. Schaub Engineering Co., Inc.—Lankton Industries, 7908 Bonhomme Ave., Clayton 5, St. Louis, Mo., has been appointed exclusive representative in eastern Missouri and southern Illinois. E. Paul Harder, head of the firm, has had 18 years in the design and application of steam specialties, return systems, pumps and boilers, according to the company's announcement.

Edward Valves, Inc.—I. Russell Berkness Co., Richmond, Va., is the new sales and service representative in the state of Virginia. The firm is headed by I. Russell Berkness, a well-known consulting engineer in the state.

Newark Gear, Inc.—William F. Hoffman, president, has announced the continuation of services of Henry J. Eberhardt as v-p in charge of engineering of this newly-reorganized company. Mr. Eberhardt has served on numerous committees of the American Gear Manufacturers Assoc., and related societies and is well known as a machine designer and technical advisor on gear design.

Purolator Products, Inc.—James D. Abeles, formerly assistant to the president, has been named v-p and general manager.

Peabody Engineering Corp.—Eric G. Peterson has been elected to the board of directors and appointed v-p. In addition to his new duties, he will continue to fill the position of general manager in charge of both the New York office and the Stamford plant.

Eric G. Peterson

Daniel B. Altman

The Kuljian Corp.—Daniel B. Altman has been appointed to head the company's new department of management engineering.

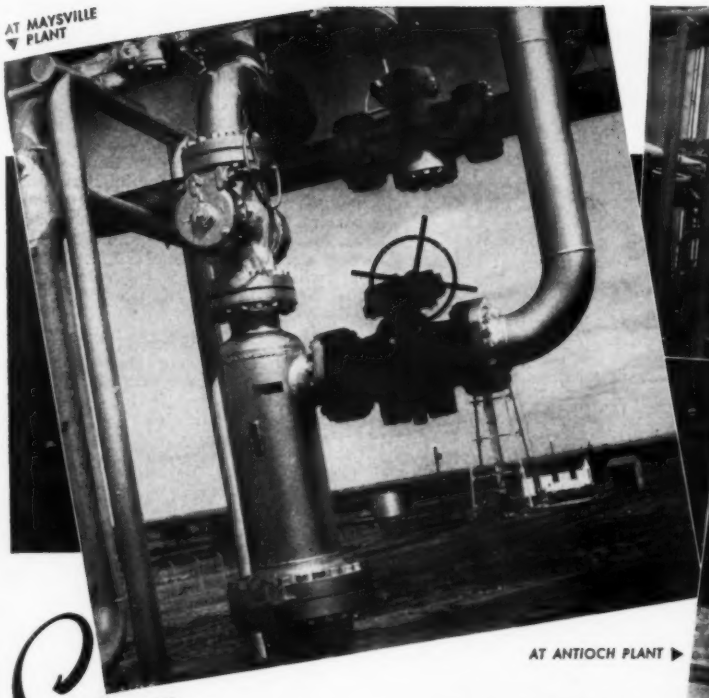
Hewitt-Robins, Inc.—Appointment of C. E. Thurston & Sons, Inc., 30-32 Commercial Place, Norfolk, Va., as distributor of Hewitt Rubber Div. products in the Norfolk area has been announced.

Dravo Corp.—A Boston sales office has been opened at 79 Milk St. with R. M. Barnes, Northeastern sales and service manager of the Dravo Heating Department in charge. In addition to the metropolitan area, the territory will include Worcester county and the state of Rhode Island.

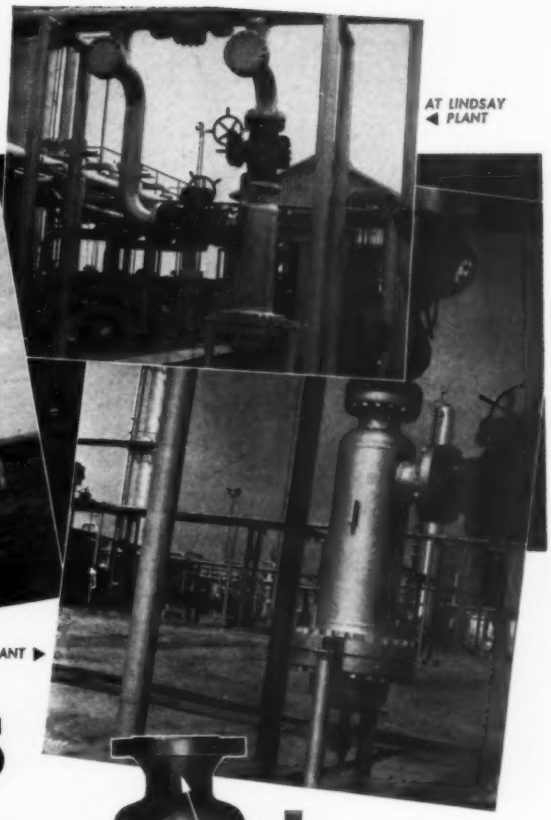
Nickel Cadmium Battery Corp.—Two new sales representatives were recently announced. In New England, J. F. Collins, Statler Bldg., Boston 16, Mass., will specialize in sales of Nicad storage batteries for electric utility applications. Valley Bearing & Equipment Co., 1 North LaSalle St., Chicago 2, Ill., has been named representative for Nicad storage batteries for diesel railway locomotive starting. The latter company, serving the railway supply field for eight years, is headed by Jean R. Huff and Armand Peycke.

Chase Brass & Copper Co.—Raymond A. Sternthall has been named branch manager of the Los Angeles office and warehouse. He succeeds the late T. Franklin Day, who died July 13, 1950.

National Electric Products Corp.—A new western region has been created within the sales organization. R. Graham Holabird is the new regional manager with offices at 400 Potrero St., San Francisco. Three district sales managers will service the new region. N. L. Bost is northwest district manager with



AT MAYSVILLE PLANT



AT LINDSAY PLANT

AT ANTIOCH PLANT

Staynew FILTERS

in One of the World's Largest Oil Field Operations

Here's a typically tough Staynew-solved problem: **at the new Garvin County plants, in Oklahoma's fabulous Golden Trend Area, highly abrasive aluminum oxide in lines carrying natural gas would cause serious damage if allowed to pass into the compressors. Staynew Filters in all three plants, processing a total of 40 million cu. ft. a day, remove all abrasive material and reduce compressor wear to a minimum.**

Special construction was required in each filter to handle pressures frequently approaching 800 PSI. Since all three plants operate 24 hours a day, dual filter installations might be expected. However, due to the exclusive Staynew design, a single filter only was needed in each plant—and experience proves that servicing is necessary no oftener than twice a year.

What Is YOUR Filtration Problem?

The above group of filters represents only *one* of the thousands of Staynew installations in critical service throughout industry. In designing filters for these installations, an unsurpassed fund of specialized information has been acquired. This information is at your service. For help in solving *your* filtration problem, whether the requirement is clean air, gas, or liquid, contact your Dollinger representative, or write direct, c/o the Dollinger Testing Laboratory.

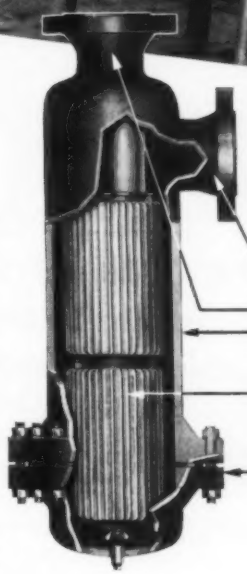


Diagram and Specifications of STAYNEW FILTERS in Service at Garvin County Plants

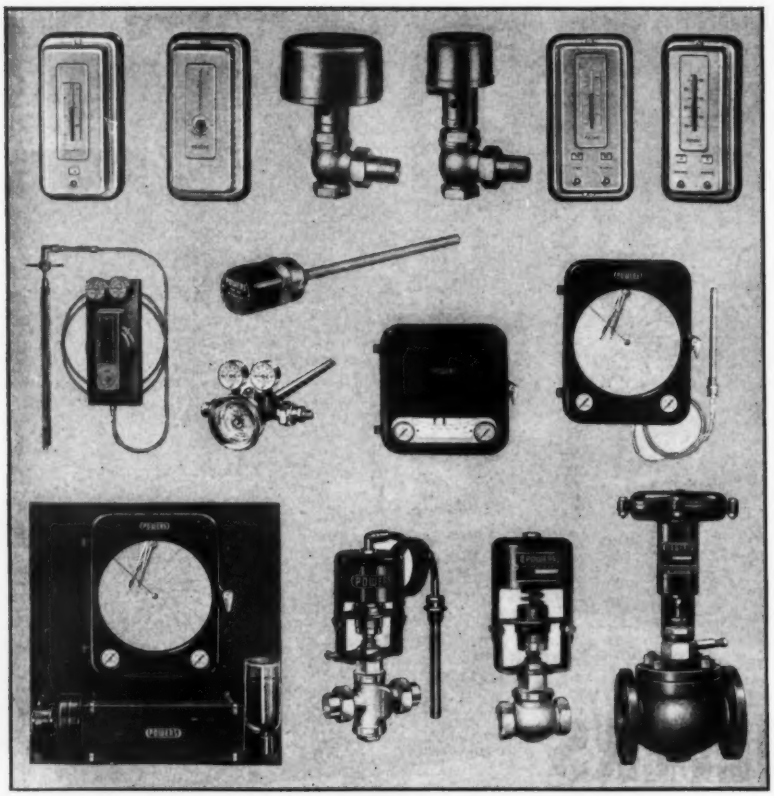
- **Inlet.**
- **Outlet.**
- **Forged steel shell, 7/8 in. thickness, certified for 800 lbs. pressure.**
- **Radial Fin Filter Inserts. Removable by simply unscrewing wingbolt after unbolting head.**
- **Bolted Head, 32 in. x 3½ in. flanges.**

Wt. 3425 lbs.

DOLLINGER CORPORATION

46 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER REG PROTECTOMOTOR U.S. PAT. OFF. STAYNEW FILTERS



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Pneumatic TEMPERATURE and HUMIDITY CONTROL for Heating and Air Conditioning Systems

★ Often Cuts Fuel Consumption 15 to 25%
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Prevent OVER-heating, save fuel, increase comfort and efficiency of people in heated rooms with a Powers pneumatic system of temperature control. A sound, highly profitable investment for—

Factory Offices, Workrooms, Process Rooms, Laboratories Schools, Colleges, Hospitals, Theatres, etc.

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for an engineer to call and study your requirements for better temperature control. An estimate entails no obligation. Write—

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headquarters in Seattle; R. E. Stone, southwest manager with offices in Los Angeles; and William D. Ross is now San Francisco district manager.

Hagan Corp.—A new Los Angeles district office has been established at 3931 Tweedy Blvd., South Gate, Calif., by this Pittsburgh combustion and chemical engineering firm and its subsidiaries, Calgon, Inc., Hall Laboratories, Inc., and The Buromin Co. The office also will represent Bull & Roberts, which is associated with Hagan Corp. in the marine engineering field.

Gould-National Batteries, Inc. — M. W. Heinritz, formerly v-p of Gould Storage Battery Corp., was elected v-p in charge of Industrial Sales at the annual meeting of the company held in St. Paul, August first.

Gould-National Batteries, Inc. became the new name of the National Battery Co. at the same meeting. The same sales and field engineering organizations, same policies, management and operation, and same Trenton, N. J., headquarters will continue.

Chiksan Co.—Clifford B. Ives & Co., 105 Forrest Ave., Narberth, Pa., has been appointed representative in the Philadelphia territory; and Rhodes Controls Co., 11 East 21st St., Baltimore, Md., will represent the Brea, Calif., company in the Baltimore area. Both of these territories were covered previously by Chiksan's eastern headquarters in Newark, N. J.

General Electric—J. David Wright has been appointed assistant manager of the company's Industry Div. at Schenectady, N. Y. In his former position as manager of the Industrial Engineering Div. will be Frederic M. Roberts. Concurrently Mr. Roberts announced that Leonid A. Umansky will become manager of engineering.

John B. Powell has been named manager of Engineering Div. of the Apparatus Department's New England Dist., succeeding George H. Jump who has been appointed engineering consultant for the district.

Three appointments in the San Jose (Calif.) Motor Div., are: Charles Stoeckly, sales manager; Carl J. Anderson, manufacturing manager; and L. A. March, engineering manager.

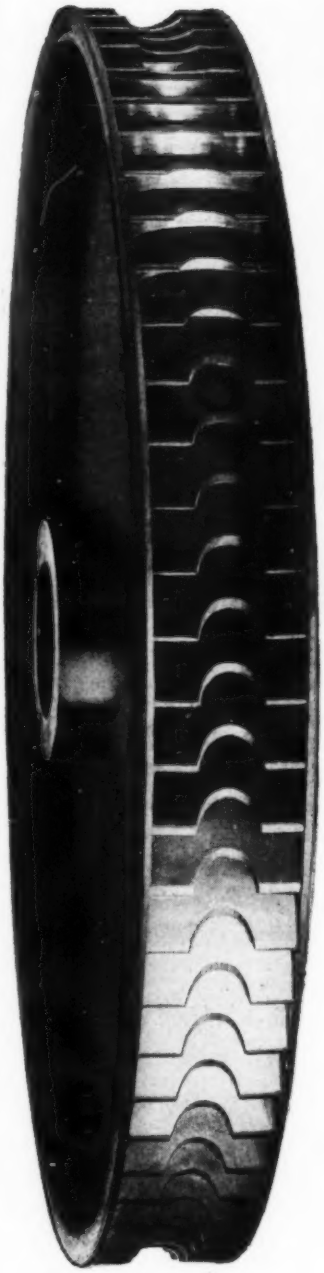
A new professorship honoring Charles E. Wilson, G-E president, has been established at the Graduate School of Business Administration at Harvard.

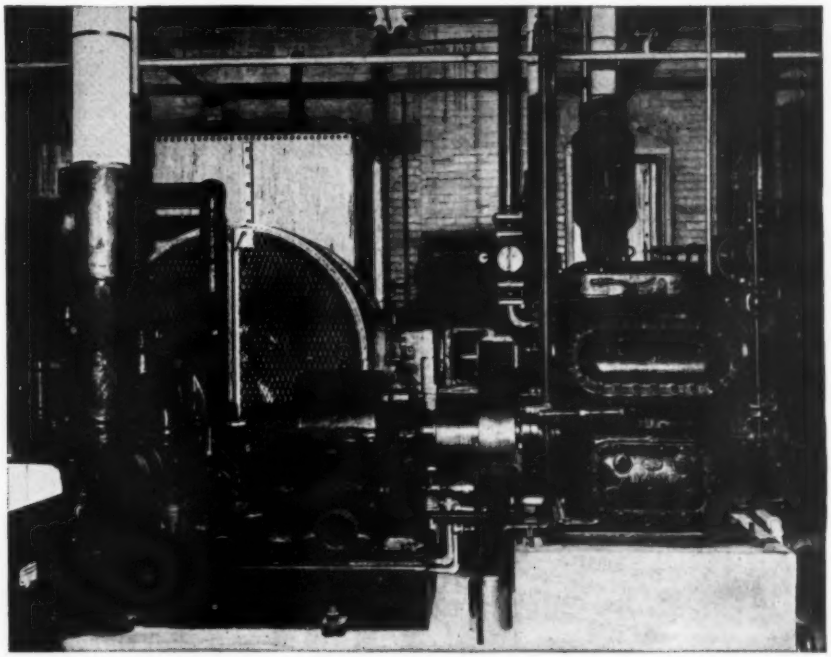
Ab Martin is the new assistant manager of the Fort Wayne (Ind.) Works of the Apparatus Dept.

Allis-Chalmers — Charles G. Vogel has been named superintendent of the electrical departments of the company's Norwood works. He started with the company in 1929 as a tester and since 1943 has been general foreman of the electrical department.

Emil Gross, formerly mechanical engineer, has been named chief engineer in the hydraulic department. He has more years, 41, of active service in the hydraulic department than any other

the Terry Turbine





Refrigeration Compressor Driven By Terry Turbine

AT HAMPDEN BREWERY

This 150 hp Terry Turbine — at the Willimansett, Mass. plant of the Hampden Brewing Co. — operates at 3800 rpm with a gear reducing it to 720 rpm. It is coupled to a 6 cylinder reciprocating compressor.

The installation is running on steam conditions of 120 psi — 0° superheat, and the steam to the turbine is automatically throttled to maintain a constant 30 psi back pressure for process and heating. The installation was developed by Fred Ophuls & Associates Consulting Engineers.

Get more information on the wide range line of Terry Turbines from your local District Representative. There's no obligation for a complete discussion of your specific requirements. Also send for Bulletin S-143 that gives full details.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

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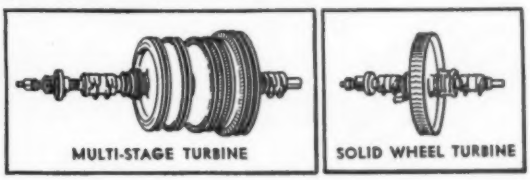
Terry



Properly Maintained Power Equipment Is Ready for EVERY TASK!

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Extra power requirements call for equipment that is kept properly maintained. The tight metal supply makes it more important than ever to keep pipes and tubes in top operating condition.

JOB

AIRETOOL tube cleaners and tube exanders are designed to do speedy, thorough repair and maintenance work. They substantially reduce expensive "down-time" and result in higher operating efficiency.

BETTER

The AIRETOOL engineering department will gladly recommend the right type cleaners, expanders and accessory tools to keep your power equipment working at peak efficiency and to save your tubes and equipment.

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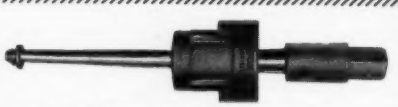
For full details write The AIRETOOL Manufacturing Company, 318 S. Center St., Springfield, Ohio. Branch Offices: New York, Philadelphia, Chicago, Houston, Tulsa, Baton Rouge.

AIRETOOL

AIRETOOL Boiler Tube Cleaner with single expansion type cutter head for removing scale from straight tubes.



AIRETOOL Boiler Tube Expander has three expanding rolls and thrust collar that bears on the tube sheet.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

There's an AIRETOOL Tube Cleaner and Tube Expander for every type of Tubular Construction

person and succeeds Col. Joseph J. Ring, who retired in 1949. Frank Jaski is the new assistant chief engineer. B. R. Nichols becomes mechanical engineer and Ralph W. Hawkins has been named assistant mechanical engineer. Also announced were the appointments of Paul D. Hess as hydraulic engineer and Arthur Bruss as chief draftsman.

Four newly-named sales representatives to the general machinery div. offices are Donald H. McIntosh and Kenneth V. Knudsen to Chicago, Delpherd H. Verhein to Milwaukee and Daniel Boland to Davenport.

Quaker Rubber Corp. — Henry M. Sossaman has been appointed general sales manager for this division of the H. K. Porter Co., Inc. Other promotions within the organization named Charles E. Dugan, assistant general sales manager; Jack R. Lewis, assistant sales manager; Thomas L. Durkin, manager of contract sales; Art M. Lowrey, Philadelphia District sales manager; and Benjamin Shawcross, manager of moulded hose department.

H. M. Sossaman

J. F. Keeler

Orr & Sembower, Inc.—The promotion of two executives has been announced. J. Frederick Keeler, sales manager, has been named v-p in charge of sales and service; and George H. Garraway, director of engineering, has been elected v-p in charge of engineering and production.

General Metals Corp. — Consolidation of three west coast manufacturing concerns to form a new corporation was recently announced. Enterprise Engine and Foundry Co., Adel Precision Products Co., and General Metals Corp., now become divisions of General Metals Corp., newly reorganized with William A. DeRidder, long head of both General Metals and Adel, as chairman of the board and William E. Butts, head of Enterprise, as president.

Black, Sivalls & Bryson, Inc.—The resignation of A. J. Smith as president of the company has been accepted and Kenneth W. Lineberry, who has been serving as chief executive for several weeks, has been elected president. Mr. Lineberry has been a member of the board of directors since 1946. He has announced his resignation as v-p and director of F. S. Yantis & Co., Chicago.

Reliance Electric & Engineering Co. —Three promotions to key engineering posts have been announced by W. R. Hough, engineering v-p of the Cleveland motor manufacturing concern. John J. Fuller has been named technical coordinator, Charles R. Sutherland

For 3500 years,
ramie fiber resisted rot
in an Egyptian tomb...

Now...Johns-Manville makes ramie fiber into the rot-resistant packing...

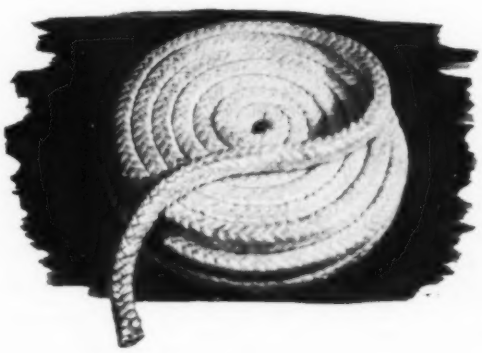
That's why *NAVALON* stands up where other packings fail!

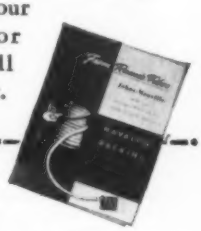
IN PLANT AFTER PLANT, this new Johns-Manville packing made from ramie fiber is establishing new records in reciprocating service against fresh or salt water, brine, cold oil and many other liquids.

Navalon's rot-resistant properties are only one reason for these outstanding performance records. Navalon also has the high tensile strength inherent in ramie, nature's strongest fiber. An exclusive Johns-Manville process of manufacture gives it unusual lubricating properties, too—another reason for its ability to outlast other cold liquid service packings. And, in addition, Navalon is free from any tendency to score.

In the toughest service, users are finding that this unique combination of properties not only means less repacking—it means less wear on rods and plungers as well—money-saving performance all around.

Why not investigate Navalon as a means of increasing packing life and reducing costs in your plant? Get in touch with your packing distributor, or send for folder PK-32A that tells the full story. Just fill in the coupon below.





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1 Recovery of valuable materials

2 Healthier and happier workers

3 Increased efficiency of plant

4 Reduced cost of equipment repair

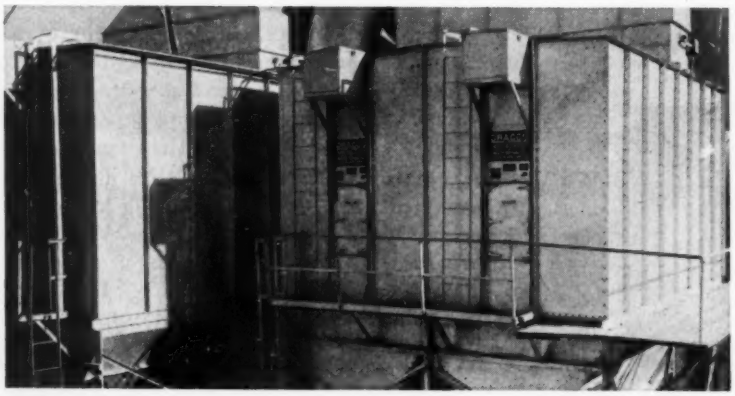
5 Eliminates occupational diseases caused by dust

6 Stops complaints by neighbors

7 Eliminates expensive law suits

8 Complies with State laws and City ordinances

● If you have dust, even in small amounts, check the 8 ways in which DRACCO Dust Control saves money and see how many applies to YOUR PLANT. Dust might be just an annoyance to you but it's presence costs you money every day. DRACCO Dust Control creates better working conditions that attracts competent workers and ALWAYS results in increased plant efficiency. Why not let DRACCO Engineers analyze your plant? They have over 35 years' experience in dust and fume control. This experience may be used by you to make your plant more efficient.



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DRACCO CORPORATION

4046 E. 116th St., Cleveland 5, Ohio New York Office: 130 W. 42nd St.

DUST CONTROL EQUIPMENT

PNEUMATIC CONVEYORS • METAL FABRICATION

has been promoted to the new position of manager of engineering for the company's Ivanhoe Div., and Earl C. Barnes will fill the third post, that of manager of engineering for the Ashtabula Div.

Compressed Air Products—Opening of a New York City office to be located at 400 Third Ave., Brooklyn 15, has been announced. The new branch will be headed by Walter R. Ellis, assisted by Martin H. Lipton and Elmer Bakelaar as sales engineers.

Eagle-Picher Sales Co.—Glen J. Christner has been named general manager of insulation operations. His new headquarters will be located in the company's general offices in Cincinnati.

The Marley Co., Inc.—Promotion of Roy W. Maze to merchandising sales manager has been announced. In 1946, he joined the Marley Co. as public relations director, the position he held until his recent promotion.

Roy W. Maze

Philip Barnes

Weston Electrical Instrument Corp.—Appointment of Philip Barnes as general sales manager has been announced. Mr. Barnes has been associated with the company for 16 years.

Combustion Control Corp.—Lester W. Watson has been named New England sales engineering representative for Fireye equipment. A graduate of Tufts college, he has an extensive background in design and application of electronic equipment.

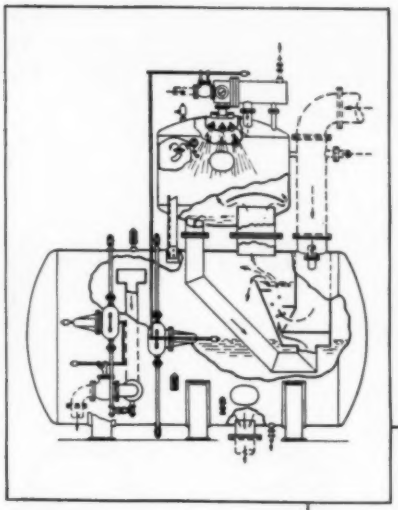
Hajoca Corp.—New and larger quarters in Staunton, Va., located at 800 Greenville Ave. (U. S. Route 11) were occupied in September. Among features of the new building are plenty of parking space for customers, enlarged store facilities and ample storage capacity.

The Okonite Co.—Dr. Robert J. Wiseman is the new v-p and chief engineer according to a recent announcement. Previously chief engineer, he joined the company in 1921.

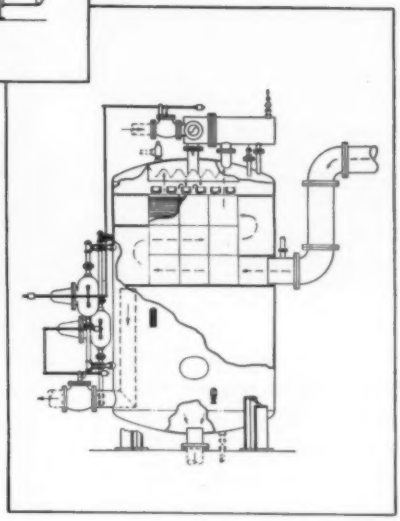
A. M. Byers Co.—Appointment of W. J. Binder as manager of the engineering service department is announced.

Flexitallic Gasket Co.—Three new agents and one new distributor were recently added to this company's field organization. The Metrol Co., Detroit, Mich., will serve the entire lower peninsula of Michigan and the Toledo area in Ohio. Power Specialty Co., Houston, Tex., will serve eastern Texas and west-

Spray



or Tray



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Each GRAVER Heater is DOUBLY guaranteed . . . to deliver water preheated to full steam temperature, and to reduce oxygen to less than 0.005 ml/liter as measured by the most precise analytical methods • **Write today for complete information.**

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Equipment for Every Water Conditioning Process

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

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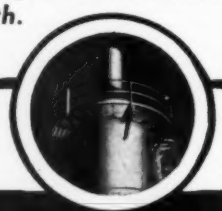
If your plant requires

- DIRECT HEATING OF VAPORS
- DIRECT HEATING OF LIQUIDS
- DOWTHERM INDIRECT HEATING
- STEAM GENERATORS
- STEAM SUPERHEATERS
- WASTE HEAT BOILERS

place the selection of the specific type in specialized hands . . . and obtain optimum efficiency.

Petro-Chem Development Company engineers are heating specialists . . . they can supply the whys and wherefores of indirect versus direct heating and the economics of both.



Every day more than 600, oil and gas fired, Petro-Chem Iso-Flow* installations in the petroleum, chemical and allied industries, demonstrate the efficiency of their design and installation.

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ern Louisiana. Illes Power Control Co., Cleveland, O., is the new agent in northern Ohio. Airdraulic Equipment Co., Buffalo will serve western New York, including the Syracuse area.

Van Auken, Ragland & Stevens—Gerald O. Fossler, formerly of Weiss & Geller has joined this Chicago firm as account executive.

J. F. Pritchard & Co.—A new district office has been opened in the Chrysler Bldg., New York City, to serve New York, New Jersey, Connecticut and Eastern Pennsylvania. The office is under the management of A. B. McClelland, Jr., who recently joined the company sales organization.

A. McClelland, Jr.

M. C. Larson

Cutler-Hammer, Inc.—M. C. Larson has been appointed manager of the Baltimore sales office, replacing R. A. Haworth who goes to the Dallas district as sales manager.

Raybestos-Manhattan, Inc. — Appointment of the California Div. of National Supply Co. as distributors for the California oil fields has been announced. The new distributorship will be handled by the West Coast div. office of Raybestos-Manhattan, Inc., located in San Francisco in charge of Littleton C. Barkley, div. sales manager, with Schuyler V. V. Hoffman in charge of the Los Angeles office.

Hartzell Industries Inc.—Ground has been broken for a $100,000 addition to the Hartzell Propeller Fan plant in Piqua, Ohio. The new addition will join the present building and will approximately double the capacity of the present plant enabling operations formerly performed in other divisions to be concentrated under one roof.

Warren Steam Pump Co., Inc.—Negotiations have been concluded for the purchase of Quimby Pump Div. of H. K. Porter Co., Inc. The purchase includes inventory, patterns, etc., and all manufacturing will be transferred to the Warren (Mass.) plant. A repair and spare parts service will be set up to take care of present and future users of Quimby pumps. Porter has announced its withdrawal from the manufacture of screw pumps in order to devote itself more fully to other lines.

Capewell Manufacturing Co. — Acquisition of V-Mac Industries, Inc., Guilford, Conn., manufacturers of pipe threading, cutting and reaming tools, has been announced. All the machinery and production facilities of V-Mac—and all of its employes—are being retained and moved to Hartford for continued production in the Capewell plant. Supervision of the production of Capewell pipe tools will be in the hands of Waynard Vosper, former president of V-Mac and designer of the tools.

Coast Counties Gas & Electric Co.—Two new appointments have been announced through R. L. Hayden, v-p and regional manager for the central California utility. Robert G. Hess has been named to the newly created position of assistant electric superintendent, and Benjamin H. Sexauer was appointed electric engineer, succeeding F. D. Beardsley, who has been promoted to the newly created position of senior electric engineer.

Hyatt Bearings Div.—Alton H. Lundius has been appointed works manager in charge of all manufacturing and service operations at the Harrison and Clark Township plants. Robert R. Guempel will be plant manager of the Clark Township plant and William H. Chapman is the new director of engineering to coordinate machine and product design, research and application engineering. Martin A. Moore has been appointed administrative assistant to the general manager, and David B. Caminez, divisional comptroller.

Superior Electric Co.—A Cleveland office serving Ohio and Western Pennsylvania was opened September first. This office, located in the Fidelity Bldg., 1940 East 6th St., will be headed by Harold W. Lorenson.

Illinois Institute of Technology — Two graduate fellowships established by the Crane Co. have been awarded to Wilbert G. Kautz of Chicago and Earl A. Phillips of Riverside, Ill. Mr. Kautz was given a grant of $2,000 and tuition for the first year, and $2,600 and tuition for the second. He will do research in flow of fluids. Mr. Phillips will receive $2,200 and tuition for one year and will do research in elasticity and experimental stress analysis.

Jeffrey Manufacturing Co.—The district office in Cleveland, Ohio, formerly in the Rockefeller Bldg., is now located at 1560 Hanna Bldg. J. W. St. John is manager.

OBITUARIES

Westinghouse Electric Corp.—John Selby Parsons, engineer and inventor died August 22 in Pittsburgh. He had helped develop electrical distribution methods for urban areas, designing the first network relays and the pump-proof network protector. He had been granted over 40 patents, mainly on substation and network distribution systems and had published many technical articles. The company honored him in 1938 with its Award of Merit.

National Electrical Manufacturers Assoc.—A. B. Smith, assistant manager of the engineering department, died August 15, at the age of 55 years. Mr. Smith had been with the NEMA since 1930 and was a member of the American Institute of Electrical Engineers.

NEW EQUIPMENT AND DEVELOPMENTS

(Continued from page 16)

handle for comfort and positive control and a suspension eye bolt to permit convenient overhead suspension. The device has a uni-

versal motor with no load speed of 3800 rpm, die cast aluminum housing for maximum strength, sealed ball bearings and fully enclosed commutator and switch.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

325—DRY COOLING UNITS ARE PORTABLE

Three DriCooler models have been added to the line of dry cooling equipment manufactured by The Marley Co., Inc. Two are small portable units, while the other model is designed to fill the need for a medium size unit. Although designed primarily for cooling engine jacket water, they can also cool natural gas, lube oils, chemical solutions, fluids of refining stages, ammonia or

condensing steam. Standard sections are made of round copper tubes with pressure-bonded aluminum or copper fins, brazed into formed steel pipe headers. They are designed to operate up to 150 psi at 300 F. Framework is made of heavy angle columns braced with angle members. Casing is heavy gage steel, stiffened with structural angles.

326—AUTOMATIC GENERATOR SUPPLIES STEAM

Portable vapor steam generator introduced by Vapor Heating Corp. supplies large quantities of high pressure steam for pile-driving, asphalt plants, chemical processing, etc. It develops 200 lb working steam pressure in two minutes from cold water and makes over 3500 lb of steam per hr at 75 to 300 lb pressure. This is accomplished by

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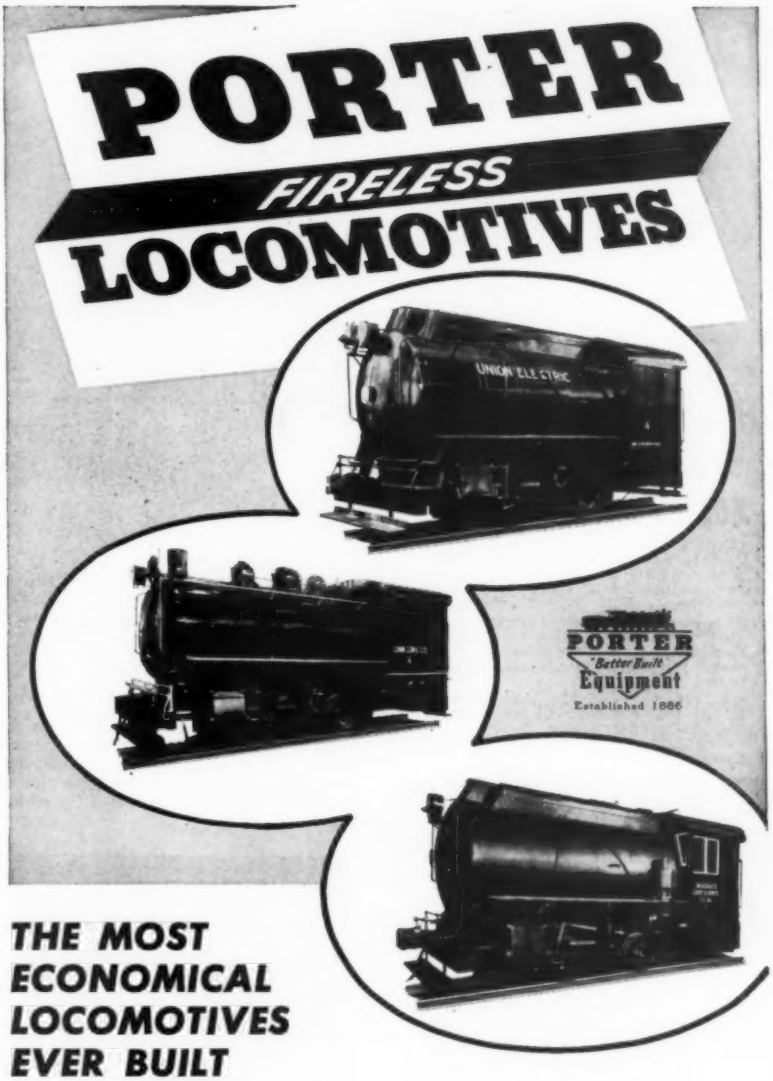
FIRELESS LOCOMOTIVES



THE MOST ECONOMICAL LOCOMOTIVES EVER BUILT

Economical because they run on excess steam from your plant boilers, because they can be operated by unskilled labor, and because they require very little maintenance. These amazingly powerful industrial plant switching units are as uncomplicated as a toy. There is no firebox, electric motor, generator, or internal combustion engine. There are so few moving parts that replacements due to wear are rarely necessary. Porter Fireless Locomotives give practically 99% availability. If you are interested in saving up to 50% of your switching costs, send in the coupon today.

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MAKES FRIENDS *and* LOWERS COSTS

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SOLVES WATER PROBLEMS

GFC and Layne engineers work closely with municipal and industrial officials for the fast, economical elimination of water treatment problems.

This complete service includes each step from the original survey of the problem to the installation of water purification equipment in the plant.

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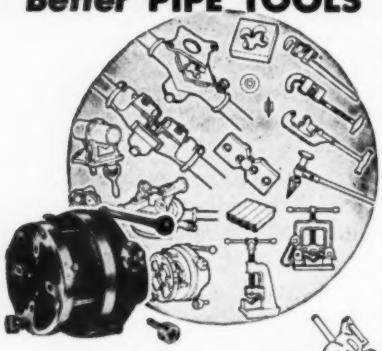
***Better* PIPE TOOLS**

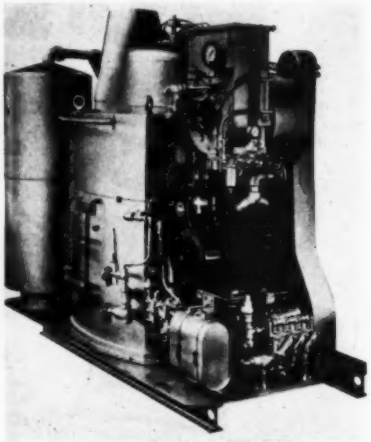


An easier, faster, better way to thread 1" to 2" pipe . . .
WITH POWER!

This light (26 lb.) compact Portable Power Pipe Threader, goes to the job — is *operated with a ½" portable electric drill.* 1 set of High Speed Steel Chasers does all sizes — just move indicator to 1", 1¼", 1½" or 2" marking. Clamp on pipe and apply drill to drive square. The rest is automatic. Operating on anti-friction bearings with automatic lead, it's a *fast,* easy way to get smooth, accurate threads.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5237 W. ARMSTRONG AVENUE • CHICAGO 30, ILL

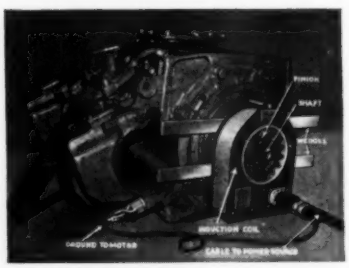
hot gases from an efficient forced-draft fuel-oil fire wiping over a special 575 ft steel coil. Features of model 4635 include addi-



tion of an economizer coil in the path of exhaust gases to increase output and efficiency, shorter unit, and higher pressure.

327—INDUCTION HEAT EXPANDS GEARS

Induction pinion heater announced by National Electric Coil Co., makes it unnecessary to apply high pressure in removing pinions. It generates heat within the pinion; the surface is not overheated and the pinion

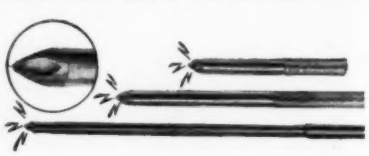


can be removed with light pressure, applied by means of either wedges or a pinion puller. Removal can be accomplished within one to two minutes.

To rapidly induce heat in the pinion, it is essential to have a good magnetic coupling between the coil and the pinion. Coils for various pinion diameters are available. The same plug and cable connection can be used with different coils.

328—SCREW STARTER FITS RECESSED HEAD

Owatonna Tool Co. announces a magnetic screw starter that fits all sizes of Phillips, Reed and Prince recessed head. The bit is designed to fit No. 1, 2, 3 and 4 Phillips as well as corresponding sizes in Reed and Prince screws and is built of heat treated

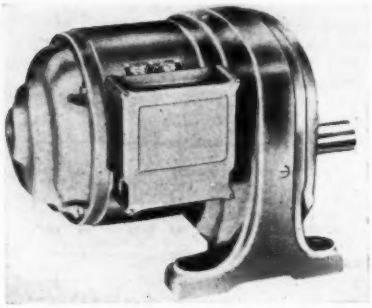


alloy steel. It is permanently magnetized. Three lengths are available: three inch (No. 730), six inch (No. 731) and nine inch (No. 732).

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

329—GEAR DRIVE WITH SINGLE PHASE MOTOR

The Sterling Electric Motors, Inc. slow-speed geared electric power drives are now available in the single phase, capacitor type motor design. These units are built with single or double reduction gears, providing



speeds from 780 down to 30 rpm, in ratings ½ to 3 hp inclusive. One outstanding feature, which greatly reduces single phase motor maintenance expense, is the starting relay. This eliminates the necessity of centrifugal switches or any rotating devices such as throw out switches, commutators and brushes.

330—FACTORY RECORDS REMAIN CLEAN

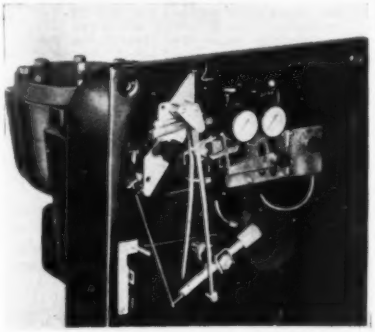
To prevent factory records, shop orders, blueprints and other production data from becoming messy, mutilated and unreadable, Joshua Meier Co., Inc. offers V.P.D. transparent plastic holders to protect and preserve valuable material. Data are easily slipped into these holders, and records can be posted

and passed from department to department so they always remain as new, spotless and clearly readable as the day they were inserted. The transparent plastic holders are made of the highest grade 5 to 20 pt cellulose acetate. They come with durable leatherette backings and bindings — some with both sides plastic (thus offering two

windows), some with leatherette back and plastic front. Available in all types and sizes to meet all possible specifications.

331—FLOW CONTROLLER HAS "O" RING SEALS

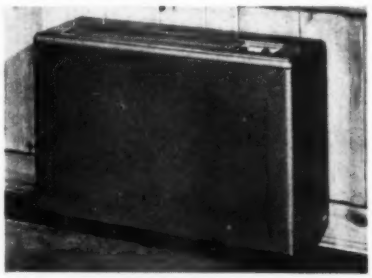
Penn Industrial Instrument Corp. has introduced an automatic flow controller, which provides low maintenance with higher ac-



curacy and fast response. Flow rate is measured by a device that utilizes a frictionless magnetic coupling between the float on one hand and the pen and control mechanism on the other. Accuracy is achieved by the large float and long float travel combined with true frictionless design. Lowest maintenance is achieved by eliminating the stuffing box or pressure tight bearing and utilizing "O" ring manometer seals in place of gaskets. The manometer is fully accessible without disconnecting the pressure piping. There is only one moving part, the float, which can easily be removed.

332—ROOM CONDITIONERS COME IN TWO SIZES

Two one-room air conditioners to be attached to a central system are now available from Worthington Pump and Machinery



Corp. These units, designated as the RVY series, are designed to condition rooms in hotels, hospitals and offices. Range of the "300" unit is from 200 to 350 cfm while the "500" unit is from 350 to 600 cfm. Each unit will contain one small 60 cycle, single phase, 115-v motor. Furnished for direct expansion or chilled water installations. Outside air may be taken through a filter or high pressure fresh air may be supplied. The units may be automatically controlled with a thermostat or manually.

333—NIPPLE CHUCK HAS WIDE PIPE RANGE

Nipple chuck for threading of short nipples is available from The Ridge Tool Co.

If you pipe it...there's a Fairbanks valve to control it

Here are two typical examples of the outstanding design, sound engineering and rugged construction that are built into every Fairbanks Valve. Years of experience in meeting all kinds of valve requirements for industry, have given Fairbanks Engineers a storehouse of knowledge in controlling the flow of water, steam, gas, oil, chemicals, etc. Consult them without obligation.

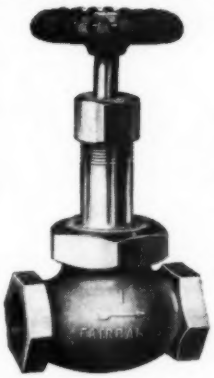


Fig. U-01
Renewable Composition Disc Globe Valve — 150 lb. S.W.P.

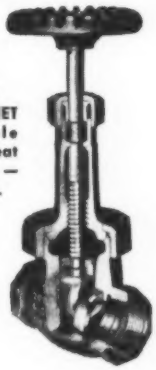


Fig. 0236
UNION BONNET — Renewable Nickel Alloy Seat Gate Valve — 200 lb. S.W.P.

THE Fairbanks COMPANY

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Branch Offices:
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DART & PIC UNIONS • TRUCKS • CASTERS

Stop these Profit Robbers with IPM*

★ IDEAL Preventive Maintenance equipment offers you the economical, quick and easy way to protect yourself against high-cost overhauls, production delays — even plant shut-downs! It prevents "sabotage" of motors and generators by sparking — high mica — poor brush contacts — excessive film — dirt and smudge on commutators and slip rings. It stops these trouble-making, profit-robbing conditions *before* they become the cause of major-expense repairs. IDEAL Preventive Maintenance has proven in thousands of plants to pay for itself many times over in direct money savings and trouble-free operation. Put it to work in your plant now!

RESURFACERS

Restore commutator and slip rings — even when ridged, scored or burned — to like new condition — WITHOUT DISMANTLING. Easy to use. Sizes and types for all conditions and sizes of motors and generators.

MICA UNDERCUTTERS

Prevent sparking — aid commutation — prolong brush life — without dismantling or taking the machine out of service when it is needed. Four models for all sizes of commutators.

PRECISION GRINDERS

For use when more than surface smoothing is needed. Grinders mount directly on brush arm or frame of the machine. No dismantling — work is done under machine's own power. Accurate to .001" Three models — for all types and sizes of commutators and slip rings.

FLEXIBLE ABRASIVE

The new, NON-DUSTING abrasive, held together by a flexible bond. Serves as both commutator and cleaner and burnisher. Removes high resistance film, dirt and grease — imparts a super-finished surface. Sizes for largest to smallest commutators.

Get this FREE

40-page handbook

Authoritative information on commutator and slip ring maintenance — what to do and how to do it! Fully illustrated. Mail the coupon today!

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Of simple design the chuck fits any threading machine or vise without special tools, parts or adjustments. It requires no adjusting or changing of the stop plug, which is an integral part of the nipple chuck. Pipe adaptors are made for ¼, ⅜, ½, ¾, 1, 1¼ and 1½ in. pipe sizes.

334—BURNERS HAVE UNIFORM FLAME DISTRIBUTION

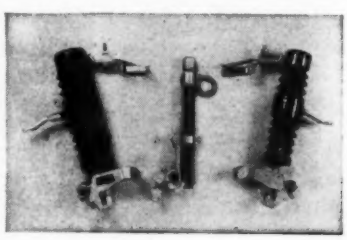
Vapofier Corp. announces a series of line burners designed for natural, manufactured, propane or butane gases mixed with air by any conventional gas-air mixing equipment. Recommended for a wide distribution of uni-

form flame, various shapes and lengths of sections are available for any pattern.

Positive ignition and flame retention take place throughout the assembly instantaneously. Constant ignition maintained by ignitor ports allows burners to be subjected to passing air without the flame "blowing off". Vapofier line burners are furnished in grey iron in capacities ranging from 10,000 to 80,000 Btu's per ft.

335—G-E IMPROVES LINE OF OPEN-DROPOUT CUTOUTS

Two 100-amp open-dropout cutouts with heavy-duty interrupting ratings of 5000 amp are available from General Electric Co.'s Transformer and Allied Product Div. in 5.2- and 7.8-kv maximum ratings. The units supplement a line of 100-amp open-type cutouts having the NEMA Standard interrupting rating of 2000 amp. Standard G-E



5.2- and 7.8-kv open-dropout cutouts already in service can be converted to heavy-duty cutouts by replacing with these interchangeable heavy-duty fuseholders. Two rubber bumpers and a coil spring prevent shock from being transmitted to the porcelain. A time delay of 5 or 6 cycles for contact-separation eliminates arcing at the contacts, which are silver plated to prevent corrosion.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

336—DEVICE HOLDS, STARTS AND DRIVES SCREWS

Screwdriver designed to increase efficiency and put an end to dropping screws is announced by the Kedman Co. It has a double spring steel blade that holds, starts and

drives the screw and is precision engineered and unconditionally guaranteed. The blade is high-carbon steel with hollow-ground bit; the handle is shockproof unbreakable Tenite II plastic. Available in 12 sizes, some with shockproof plastic-covered tubing for electrical work.

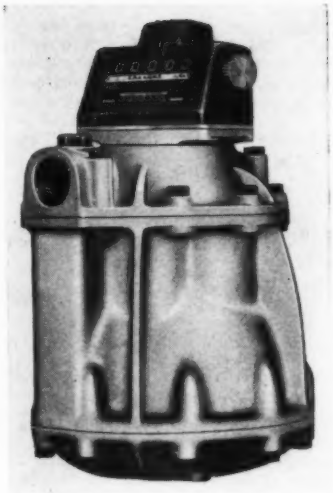
337—TESTER CHECKS GROUND RESISTANCE

CVM type of Megger ground tester is announced by James G. Biddle Co. for measuring resistance of ground connections. It provides a dependable and easy method for ascertaining if resistance to earth of man made grounds will insure correct operation

and minimize dangers due to lightening. This set has its own generator for supplying test current. Two ranges are available, 0 to 40 and 0 to 200 ohms; 0 to 100 and 0 to 500 ohms.

338—DISPLACEMENT METER HAS 110 GPM CAPACITY

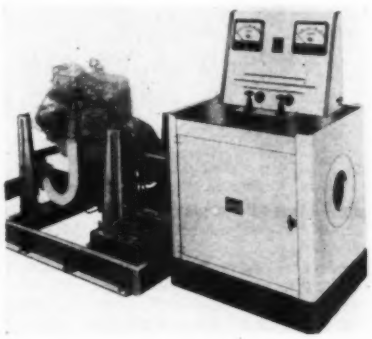
Industrial liquids and petroleum products meter has been added to the Bowser, Inc.'s line of Xacto meters. This positive displacement meter has five vertical pistons



and was developed to meet a demand for highly accurate measurement, in the 110 gpm range. All interior parts are constructed of either special hard carbon or stainless steel to eliminate metal-to-metal contacts at friction points. Cylinder block and bowl are available in cast iron or bronze. Straight reading, predetermined quantity or ticket printing dials can be supplied.

339—ENGINE DYNAMOMETER HAS 50 TO 2,000 HP RANGE

Compact, low cost engine dynamometers designed for engine run-in in service shops and end of production line testing have been



placed on the market by the Clayton Mfg. Co. These models will operate with horsepower ratings from 50 to 2,000. Each unit will handle an extremely wide range of speeds and powers, thereby making possible the testing and "running in" of a variety of engines on the same machine. Conditions can be varied instantly or maintained indefinitely without the slightest change. Loads may be increased or decreased and then re-established without sacrificing accuracy.

340—PIPE MACHINE HAS TWO TYPES OF CUT-OFF

A choice of either wheel and roller cut-off or knife cut-off is now offered on the Toledo No. 999 super model 2 in. power pipe machine manufactured by the Toledo Pipe Threading Machine Co. The wheel cut-off is equipped with two rollers and one cutter wheel, which is self-centering and easily fed with hand wheel. This device cuts

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For Longer Service

This True Ball Joint Makes the Difference

Easy to Tighten! Because of the spherically-ground joint, Dart unions always fit snugly — bronze seat to bronze seat. Moreover, they close easily and stay tight. No need to jam a Dart.

Easy to Uncouple! Darts uncouple easily, too. Seats are unmarred—ready for repeated use.

Practically Indestructible! To ensure the ultimate in protection, both body and nut of a Dart are made of practically indestructible high-test, air-refined malleable iron. One more of the many reasons why Darts are first choice of careful buyers coast to coast.

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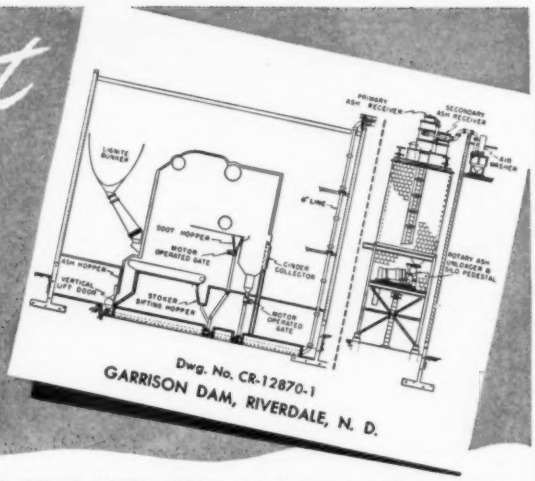
DART
UNIONS

Beaumont

SOLVES LIGNITE ASH HANDLING



At the GARRISON DAM, RIVERDALE, NORTH DAKOTA, this Beaumont installation handles lignite ash and soot with a steam actuated Vac-Veyor System. Under this system, clogging of the venturi and resultant shut-down have been eliminated. Also, as shown above, the air washer is located inside the boiler house; this prevents the water from freezing during North Dakota's sub-zero winter . . . Whether your material handling problem is unusual or not, write today for prints of typical Beaumont installations.

Beaumont BIRCH COMPANY

1509 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS

HENSZEY

PACKET-TYPE *Automatic* CONTINUOUS BLOWDOWN

- Prevents PRIMING
- Prevents FOAMING
- Prevents SLUDGE
- Prevents SCALE

(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

Also...

Standardized or special units for ALL CAPACITIES.

HENSZEY

Consult your nearest HENSZEY Representative for FREE Blowdown Chart or write to

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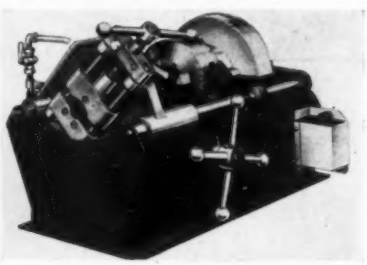
Flow Indicators • Proportioning Valves

Also MILK EVAPORATORS and PREHEATERS

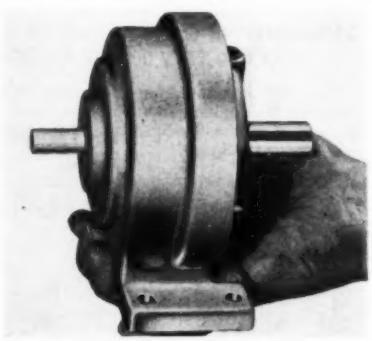
off pipe rapidly, leaving a clean cut, and is extremely simple in design with few moving parts. The knife cut-off is furnished with four cutter knives, which leave a straight square-end cut without burr. Blades are fed through a scroll by a small hand wheel and



may be resharpened. Cutting is rapid with either type, cutting off 2 in. pipe in 10 seconds. A convenient thread gage shows length of thread being cut. A new flexible oil line is also incorporated in the design.

341—SPEED REDUCER HAS 1000 IN.-LB CAPACITY

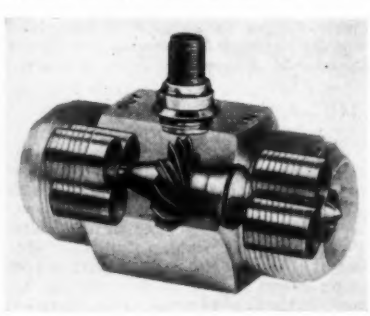
Speed reducer, designed to save cost and conserve space in all in-line reducer applications in the ¼ to 1 hp range, has been announced by the Universal Gear Corp. Designed as the Model 5-E, it is suitable for



any straight-line installation in which the input rpm does not exceed 1800. Maximum torque capacity is 1000 in.-lb. Features include anti-friction ball bearings throughout; quiet operation and lower cost; simplified design and a reduction in number of working parts; and high efficiency.

342—FLOW METER HAS SENSING ROTOR

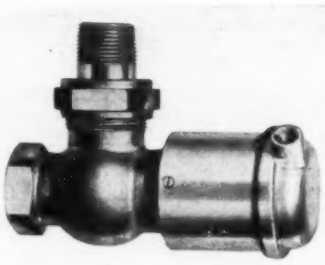
The Potter Aeronautical Co.'s electronic flowmeter incorporates a high-efficiency sensing rotor, which spins freely within a venturi. Three circular spring clips at each



end maintain the guide bearings for the rotor shaft. Fluid flow turns the rotor at a speed determined by velocity of the liquid and rotor blades pitch. A cylindrical permanent Alnico magnet within the rotor sets up a rotating field, which generates alternating current in the pickup coil. Frequency is equal to the speed of the rotor when the magnet is two-pole. A four-pole magnet provides twice this frequency. A single, shielded wire conducts the current to an electronic unit, which either integrates it into direct current for operating a rate-of-flow meter, or counts the cycles on an electro-mechanical counter.

343—PISTON VALVES FOR CONFINED SPACES

Control valves with piston operators, for convector installations and other applications in confined spaces, has been developed by Johnson Service Co. Extremely small in

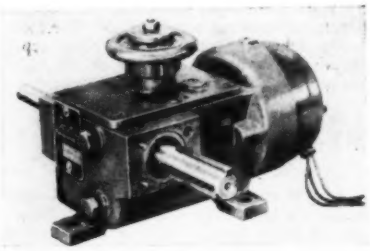


size they are adaptable to almost any type of piping connection for accurate proportional control of low pressure steam, hot or cold water. Made in ½ and ¾ in. pipe sizes. In addition to conventional union angle and union globe patterns, reverse flow, double-union angle and female union inlet globe bodies are offered.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

344—GEAR MOTOR FOR COMBUSTION CONTROL

Janette Mfg. Co. has announced the addition of model "BO" type gear motor to its speed reduction line. Developed especially

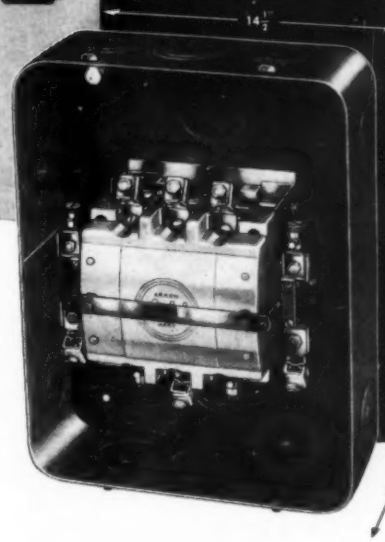


for application to combustion control systems, the unit uses double reduction worm gearing to furnish an output speed of 0.4006 rpm and approximately 220 in.-lb output torque. Speed reduction ratio is 4242.4 to 1. Furnished with a 3-lead single-phase, 60-cycle, 115-v 1725 rpm capacitor-start, ca-

NEW SIZE 4 "RA" MAGNETIC STARTERS

ARROW AH HART

½ CONVENTIONAL SIZE



- EASY TO WIRE
- EASY TO SERVICE
- SILICON-CHUTE ENCLOSED CONTACTS

SIZE 4 ILLUSTRATED

SMALLEST SIZE 4 ON THE MARKET — Patented "RA" (Right Angle) Balanced mechanism cuts space in half. HIGH ARC RESISTANCE — Long arc path; silicon-chute enclosed contacts, shaped to force arc to extinction. EASE OF WIRING AND SERVICING — Straight through wiring, plenty of working space in the box; terminals front-wired; line and loads connect at opposite ends. 4-PILLAR ALIGNMENT — Assures straight line action, greater stability. FOR ITS SPACE-SAVING FEATURES, FOR ITS WORK-SAVING FEATURES, THE NEW AH SIZE 4 "RA" MAGNETIC STARTER IS THE SENSIBLE ONE TO SPECIFY AND BUY.

Write today for literature on Arrow-Hart Type "RA" Magnetic Starters, available in local and remote control or selector switch types — all sizes.

CONTROLS and APPARATUS FOR *Outstanding* PERFORMANCE

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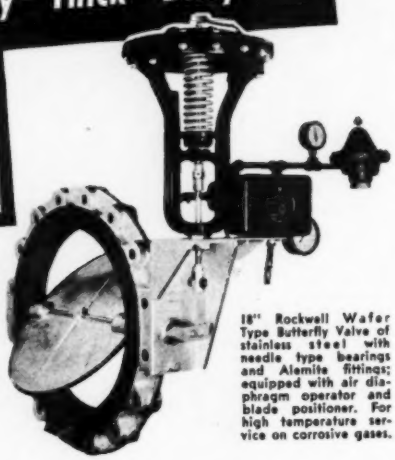
GET BETTER CONTROL OF GASES • LIQUIDS OR SEMI-SOLIDS MANUALLY OR AUTOMATICALLY

✓ In Large Volume or Small
✓ At High or Low Pressure
✓ Cold, Normal or Hot
✓ Corrosive or Abrasive
✓ Heavy – Thick – Dirty

WITH

ROCKWELL VALVES



Rockwell Butterfly and Slide Valves in sizes from 1" to 72" and larger, with manual or various automatic controls, are easy to install, convenient to operate. They provide maximum flow rate and quick opening or shut-off. They pay their way in better fluid handling. We invite your inquiries. Write for the Rockwell valve catalog.

18" Rockwell Wafer Type Butterfly Valve of stainless steel with needle type bearings and Alemite fittings; equipped with air diaphragm operator and blade positioner. For high temperature service on corrosive gases.

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Save Fuel

Determine CO_2 Content in Boiler Flue Gases

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ENGELHARD ANALYZER

MAIL COUPON TODAY

For higher combustion efficiency, less fuel loss, the Engelhard CO_2 Analyzer gives complete, sensitive, accurate analyses by the thermal conductivity method perfected in the Engelhard laboratories. Bearing the approval of the U. S. Bureau of Standards and other important authorities, the thermal conductivity method combines simplicity of equipment with extreme accuracy.

The Engelhard Analyzer is supplied to meet individual CO_2 problems. Engelhard 0-5%, 0-10% and 0-20% types indicate the range available. For further information just fill out the coupon below.

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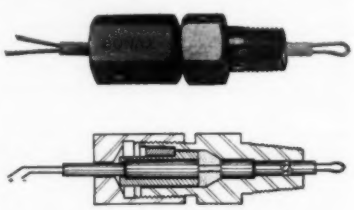
CE-104

CHARLES ENGELHARD, INC.
850 PASSAIC AVENUE, EAST NEWARK, N. J.

pacitor-run motor, it is instantly reversible up to 20 times per min. Weighing about 12 lb, the unit measures 8⅜ in. long, 9 3/16 in. wide, and stands 5 11/32 in. high with foot mounting base.

345—GLAND SEALS BARE THERMOCOUPLES

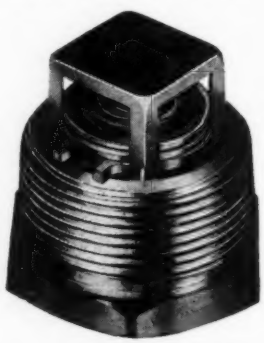
Bare wire thermocouple gland has been announced by Conax Sales Co. Inc. It is designed to provide greater accuracy and quicker response of bare wire thermocouples without leakage and expense in a closed vessel under positive or negative pressures.



Rapid interchangeability of all parts permits use of any thermocouple wire as required and makes the life of the thermocouple gland independent of the bare wire. Gland may be used with temperatures from minus 100 to plus 1600 F and will withstand pressures up to 4000 psi. Body and caps are made of type 304 stainless steel.

346—CHECK VALVES FIT ALL APPLICATIONS

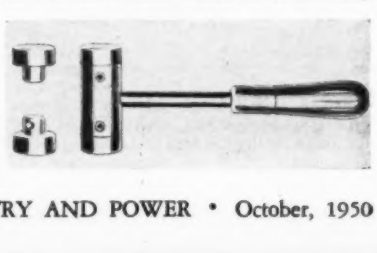
Durabla Mfg. Co. has announced a standard line of check valves that represent the utmost in simplicity and utility. There are only three valve parts plus the seat and a



locking ring for easy assembly. The basic check units are ready for immediate installation in all standard pipe fittings. One basic design takes the place of all other types including swing-checks, ball-checks and clapper-checks as well as air checks.

347—HAMMER DESIGNED FOR PERFECT BALANCE

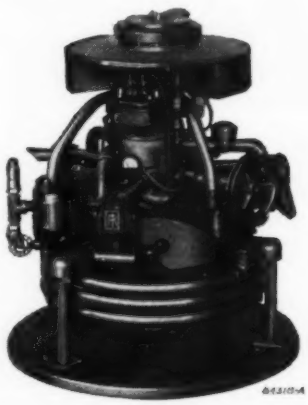
A series of "Softip" hammers with longer handles, a hand grip shaped for a comfortable fit and a ferrule made of brass tubing



is announced by Gregory Tool and Mfg. Co. The device is furnished with renewable copper, brass and plastic tips or solid copper, brass and plastic heads. Sizes from ¾ to 1½ in. dia weigh from 3 oz to 2½ lb. Sizes from 1¾ to 2½ in. dia weigh 4¼ to 10½ lb and have leather washer grips assembled on steel shafts to absorb shocks.

348—AIR COMPRESSOR UNIT HAS PORTABLE FEATURES

Ingersoll-Rand Co. now has a light compact gasoline-driven air power unit having a capacity of 36 cfm at 80 psi. It weighs 265 lb and stands 32 in. high on a 27 in. dia baseplate. A special wheelbarrow mounting enables one man operation. Three power cylinders and three air cylinders are spaced

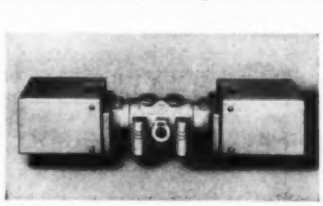


alternately at 60 degree intervals around a vertical single-throw crankshaft. The four-cycle gasoline engine is equipped with overhead alloy steel valves with adustable tappets. Fuel-tank capacity permits from 2 to 2½ hr continuous operation.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

349—DOUBLE SOLENOID HYDRAULIC VALVE

Double solenoid-operated, 4-way hydraulic valve announced by Rivett Lathe & Grinder, Inc., is the series 5500 designed for use as a



semi-automatic electric control of a hydraulic circuit. The two solenoids are continuous duty push type and the hydraulically balanced piston has an integral spool and stem. The entire piston surface is hardened, ground and lapped. Designed for pressures up to 1500 psi, it is available in 1/4, 3/8, 1/2, 3/4 and 1 in. sizes for 110, 220, and 440 v, 50 or 60 cycles.

NON-FLUID OIL
TRADE MARK REGISTERED

Provides Better Lubrication At Less Cost Per Month

Produced from the highest grade petroleum, NON-FLUID OIL overcomes the drawbacks inherent in ordinary oil and grease.

Every drop of NON-FLUID OIL stays right where it's needed to do a full-time lubricating job. When you use ordinary oils, two drops drip away for every drop that gets where needed. You pay for three gallons of oil, but only one gallon works for you. Because NON-FLUID OIL eliminates this waste, you save on both lubricant and application cost and get increased lubricating efficiency.

NON-FLUID OIL provides positive lubrication upon split-second demand because, unlike ordinary greases, it does not require softening by frictional heat before it will feed and reduce friction.

Send for instructive bulletin and free testing sample of NON-FLUID OIL.

NEW YORK & NEW JERSEY LUBRICANT COMPANY
292 MADISON AVENUE, NEW YORK 17, NEW YORK WORKS: NEWARK, N. J.

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NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

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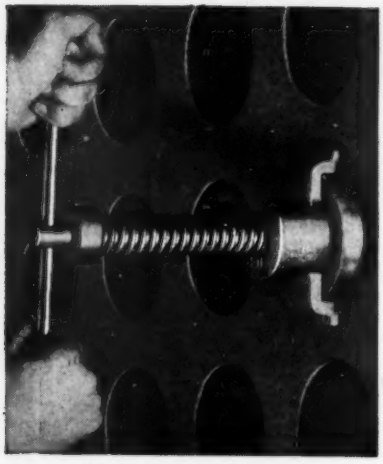
48 man-hour job done in only 4 hours with a ROTO Hand-hole Seat Scraper



Illustrating ease of operation of Roto Hand-hole Seat Scraper.

If you operate any of the boilers listed below, you can't afford to be without a ROTO Hand-hole Seat Scraper.

A Pennsylvania manufacturer reports that it formerly took three men 2 to 3 days to clean inside cap seats on a Keeler Boiler header. Now, with a ROTO Hand-hole Seat Scraper, one man does it in four hours, besides doing a better job.

This simple, hand-operated tool is equipped with retractable knives mounted on the end of a revolving spindle having a bearing in a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Write for bulletin and prices.

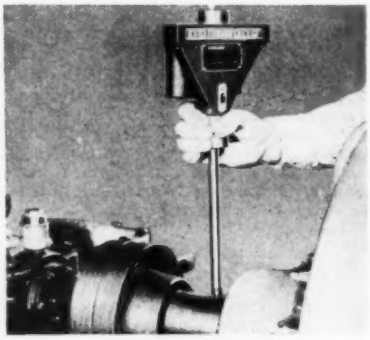
MAKE OF BOILER	TUBE SIZE	OPENING
Babcock & Wilcox	4"	Oval
B. & W. No. 40 Header	3¼"	Oval
B. & W. No. 41 Header	2"	Oval
B. & W. Superheater	2"	Round
Babcock & Wilcox	4⅛" x 5"	Square
Casey Hedges	4"	Oval
Casey Hedges	3½"	Oval
Combustion Engineer'g	3"	Round
Edge Moore	4"	Oval
Franklin	4"	Round
Geary	4"	Oval
Heine	3½"	Oval
Heine	3½"	Round
Keeler	4"	Round
Keeler	4"	Diamond
Murray	4"	Oval
Murray	3½"	Oval
Oil City	4"	Oval
Oil City	3½"	Oval
Union Iron Works	4"	Pear Shape
Walsh & Widener	4"	Oval

Roto Hand-hole Seat Scraper for Heine Boiler.

ELLIOTT COMPANY-ROTO DIVISION
156 Sussex Avenue **Newark 1, N. J.**

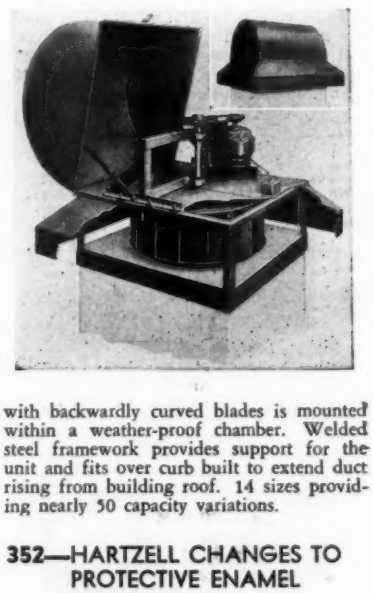
350—DIRECT READING METER FOR MACHINE VIBRATION

The Davey Vibrometer Model-P, manufactured by The Vibroscope Co., is an instrument for measuring machine vibrations. Width of oscillation of a light beam on a graduated ground glass scale indicates amplitude. Two models are available that magnify vibratory motion 250 and 125 times respectively. Flash light batteries are housed within the instrument. One feature is a detachable probe 8 in. long that permits measurements directly on the surface of a rotating shaft.



351—ROOF VENTILATOR HAS LOW NOISE LEVEL

Ventilator suitable for duct exhaust, operating at very low noise levels, is announced by The Swartwout Co., under the trade name "Airlift". A centrifugal type fan with backwardly curved blades is mounted within a weather-proof chamber. Welded steel framework provides support for the unit and fits over curb built to extend duct rising from building roof. 14 sizes providing nearly 50 capacity variations.



352—HARTZELL CHANGES TO PROTECTIVE ENAMEL COATING

Translucent deep blue enamel is now being used on all fans and blowers manufactured by the Hartzell Propeller Fan Co. instead of ordinary gray paint. In line with the current demand for color attraction-value in production plants, the enamel more than triples the protective qualities of the coating against abrasion and most acids and alkalies. Spraying insures uniform and complete coverage of metal parts.

NEW BULLETINS

(Continued from page 24)

als and typical installation photographs are included in 36-page booklet. Hapman Conveyors, Inc.

Screen Separators (2W). Illustrated 24-page brochure describes Gyrocentric screens for all types of wet and dry separations. Includes installation photographs, drawings, specifications and detailed application information. The Patterson Foundry and Machine Company.

Traveling Cranes (2X). Chock full of installation photographs, this 8-page booklet shows the wide range of applications available with overhead electric material handling equipment. Northern Engineering Works.

Conveyers (2Y). Small parts, scrap and chip handling are featured in 60-page book, illustrated with over fifty pictures and sectional drawings. Several pages are devoted to overload cutouts for pulley or direct power drives. Anchor Steel & Conveyor Co.

Pneumatic Tube Systems (2Z). Interesting 6-page bulletin tells how pneumatic tube systems reduce costs. Describes and illustrates four installations in different types of plants. Standard Conveyor Co.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Conveyers (3A). Case histories showing actual dollar savings feature 36-page well illustrated bulletin. Sketches of 16 typical systems, together with 12 types of conveyers are presented. Logan Co.

Light Load Conveyers (3B). Drawings of typical installations, along with general description, components, general data and special features comprise 12-page bulletin on light weight, spiral thread cable conveyer. Teleflex Inc.

POWER TRANSMISSION

Variable Pitch Sheaves (3C). Simple method of instant speed control covering most speed changing needs from 1½ to 40 hp is described in 12-page bulletin. Instructions and tables to figure the components needed to assemble a drive are included. Allis-Chalmers Mfg. Co.

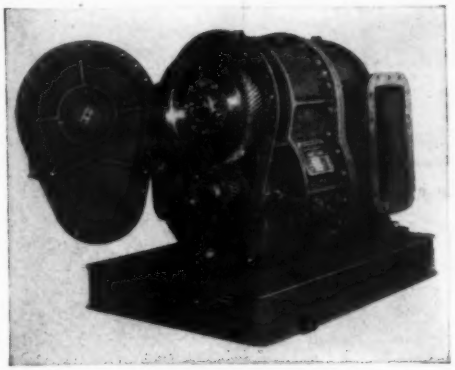
Leather Belting (3D). New simplified price list for leather belting items, is offered by: Philadelphia Belting Company.

Hydraulic Drives (3E). Latest developments in hydraulic drives are given in 16-page house organ. Brief history of hydraulic power transmission is

The **STANDARDAIRE**

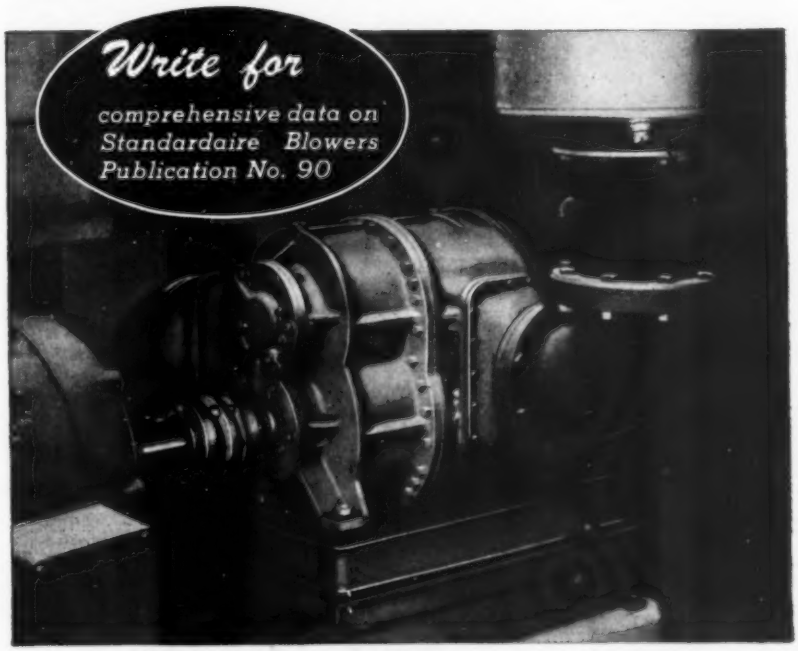
PRECISION BUILT

Axial Flow **BLOWER ~**



Here's another important design feature of the Standardaire Blower —HEAT TREATED ALLOY STEEL TIMING GEARS—generated and shaved to extreme accuracy for quiet operation.

THESE helical gears keep the cycloidal form, screw type rotors of the Standardaire Blower in timed relation. There is no wind-up in the shafts between the rotors and gears as a very small percentage of the in-put power goes through the timing gears. The male or main rotor does the work and consumes the power; the female rotor acts simply as a valve or gate—further evidence of the finer features found only in the Standardaire Blower. The Standard Stoker Co., Inc. Dept. C-10 Lexington Ave., New York 17, New York.



● Typical installation of a Standardaire Blower as installed in a malting plant.

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Standard Stoker SSC

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traced, followed by illustrated applications of the newest developments. Twin Disc Clutch Co.

Gear Speed Reducers (3F). Some 190,000 combinations of sizes, ratios and types are covered in an 8-page, condensed, quick reference bulletin. Contains complete information on ratings of all sizes and types, dimensional drawings, and specifications. Cone-Drive Gears, Div. Michigan Tool Co.

Worm Gear Drives (3G). Three basic types, each available in 10 different sizes, for fractional or large horsepower, and in speed ratios of 3⅝ up to 8,000 to 1, are illustrated, described and tabulated in 80-page book. Five pages are devoted to typical drive problems with solutions. Link-Belt Co.

PUMPS AND ACCESSORIES

Industrial Pumps (3H). Pumps for industrial use are covered in the following bulletins: "Boiler Feed Pumps for the Power Industry", available in five standard models for capacities from 5,000 to 1,000,000 lb per hr at pressures to 2,800 psi. "Deepwell Turbine Pumps," for installation in wells from 6 to 24 in. or larger. "Centrifugal Pumps" features various types including, single stage single suction, single stage double suction, pneumatic "sponge" pumps, sewage pumps, sand and gravel pumps. Byron Jackson Co.

High Pressure Pumps (3J). Recently designed 5 in. stroke multiplex direct flow pumps are described in 6-page bulletin that covers construction, specifications, and drive requirements. Included are: pump selection chart, dimension drawings, plunger, pressure and other data. The Aldrich Pump Co.

Impeller Pumps (3K). Pumps with two-vane closed impellers in various types and sizes are described in a 16-page booklet. Line drawings, general data, performance curves, fittings of standard pumps, shafting charts, sizes of motor stands required are shown. Worthington Pump & Machinery Corp.

Self-Priming Pump (3L). Complete information on new self-priming centrifugal pumps now available in 8-page bulletin. Sizes from ¼ to 5 hp, with capacities to 120 gpm and heads to 135 ft. Also given are general description, principles of operation, construction details, specifications and two pages of performance data. Goulds Pumps, Inc.

Pump-Motor Unit (3M). Design and construction features of close-coupled pump and motor are described in 6-page folder. Available with drip-proof, splash-proof, totally-enclosed, fan-cooled or explosion-proof motor enclosures, in ratings from 10 to 500 gpm at heads to 220 ft. Motors are rated from ¾ to 10 hp. Allis-Chalmers Mfg. Co.

TOOLS AND SPECIALTIES

Tube Expander (3N). Expander for rolling condenser and heat exchanger tubes features an adjustable ball bearing thrust collar. Developed for automatic control driving units, it is fully

described in 4-page bulletin that also contains handy order and price list. A. L. Henderer's Sons.

Power Drive Pipe Cutter (3P). Pipe cutter with range of ⅛ to 2 in. and designed for utilizing any make of power drive is fully discussed in 4-page flier. Companion tool, a quick-opening, adjustable from ½ to 2 in., pipe threader is also listed. Beaver Pipe Tools, Inc.

Retaining Rings (3Q). Complete line is described in 8-page catalog. Rings are grouped according to basic use. Data is given for each ring together with typical application drawings. Includes information about materials, and accessories. Waldes Kohinoor, Inc.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Metal Fastenings (3R). Important new items have been added to 92-page descriptive catalog. These include a complete line of machine screw nuts which are double counter sunk and double chamfered. All types of bolts, screws, nuts and washers are presented. Quick reference price list is included. Atlas Screw & Specialty Co.

Cabinet Bench (3S). "Custom" features of improved stock bench are shown in 8-page catalog. All-steel construction, storage space, standardized units and interchangeable accessories are illustrated and described. Standard Pressed Steel Co.

VALVES, PIPING AND FITTINGS

Monel-Trimmed Valves (3T). Actual case histories given in "Trimming Valve Costs with Lasting Trim" show the long service obtainable with these valves. Available in any type and size. The International Nickel Co., Inc.

Air Relief Traps (3U). Ball float traps for venting air from any liquid under pressure are described in 2-page bulletin. Complete physical data, hookup diagrams and cross-sectional drawings are incorporated. Armstrong Machine Works.

Air Eliminators (3V). Illustrated bulletin tells all about float type for low pressure steam and hot water convector or radiant heating systems. Sarco Co., Inc.

Flange & Coupling Selector (3W). Engineers working with pipe and pipe connections will appreciate this handy slide rule that presents at once, all pertinent data for 150 and 300 psi ASA Standard as well as for standard, extra heavy, 3000 and 6000 psi couplings. Table shows wall thicknesses of standard, extra heavy and double extra heavy pipe as well as for all schedules of pipe from 10 through 160. Nooter Corp.

Welding Fittings (3X). Well illus-

IT'S EASY TO MOVE A SCHRAMM AIR COMPRESSOR!

When your plant layout changes . . . or you need an air compressor in a different building . . . the quickest way to transfer and make installation is to use Schramm Air Compressors. They are compact and easy to handle because compressor and motor are mounted as a single unit on a substantial steel base, which also serves as a foundation.

In addition to easy handling and installing, Schramm Air Compressors are vibrationless and built for heavy-duty twenty-four hour service. There is only one price tag on a Schramm.

For your many compressed air jobs about the plant, specify SCHRAMM—and save. Write for folder STF-50.

A complete assortment of Schramm accessories essential to modern industrial installations including after-coolers, moisture separators, air controls and other accessories, is available.

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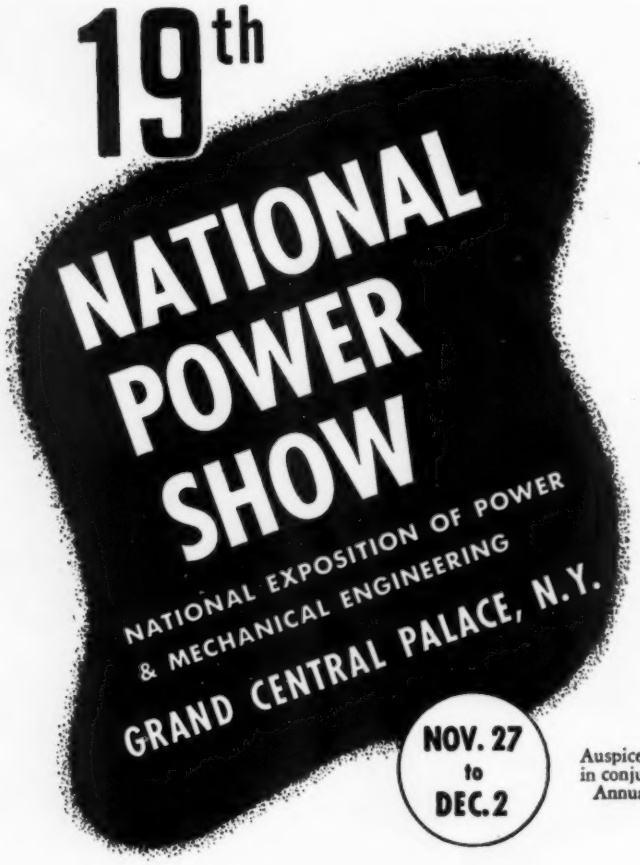

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SEE more than 300 informative exhibits and demonstrations of latest techniques, equipment, and supplies for more efficient power production, mechanical transmissions and utilization, materials handling, and plant services.

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Management International Exposition Co.

trated 40-page catalog lists a full line of welding fittings, complete with dimensional drawings and specification tables. Each type of fitting is thoroughly discussed and construction details are described. Table of American Standard tolerances for welding fittings, forged steel flanges and welding bevel round out the book. Midwest Piping & Supply Co.

Hydraulic Tube Fittings (3Y). Exclusive and vital design requirements feature 12-page booklet on the flare and no-flare type. Drawings and complete engineering specifications are shown. Flodar Corp.

Seamless Tube Handbook (3Z). Pocket sized reference handbook on methods of working intermediate Croloy seamless tubes and pipe is carefully indexed and well illustrated with photographs, diagrams and reference tables. Information on composition, general characteristics, annealing practice, methods of hot and cold working, welding and condensed technical data is given. Babcock & Wilcox Tube Co.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Pipeline Protection (4A). Protecting pipelines against moisture, alkalies, acids, oils and fungi through the use of polyvinyl chloride tape is described in 4-page brochure. Tables of the tape's chemical, physical and electrical properties are presented along with a series of application technique photographs. Minnesota Mining & Mfg. Co.

Chemical Resistant Plastic (4B). Properties and fabrication of Saran-lined steel pipe, fittings, and valves are dealt with in an illustrated catalog. Photographs, cross section, and dimensional drawings are included. Dow Chemical Co.

Hydraulic Control Valves (4C). Catalog presents complete data relative to recent developments on these valves. Front page lists 17 valve classifications and 102 models are described in 22-page booklet. Logansport Machine Co.

HEATING, VENTILATING AND AIR-CONDITIONING

Air Diffusers (4D). Engineering data and formulas for calculations used in solving air conditioning problems are given in 6-page folder. Facts about aspirating air diffusers are contained, as are a number of diagrams. Anemostat Corp. of America.

Unit Heater (4E). Specification and dimension data together with a description of important features are contained in 2-page bulletin on newly modified blower type heater. Reznor Mfg. Co.

MISCELLANEOUS

Visible Data Holders (4F). Transparent plastic holders to protect and

preserve records, orders, blueprints and other data are pictured and described in 20-page catalog. Contains specifications, dimensions and finishes along with price list. Joshua Meier Co., Inc.

Fire Hazard Index (4G). Lists 590 fire hazards and their proper fire-fighting agent. Pocket-sized 36-page booklet also contains basic facts on fire-fighting. Randolph Laboratories, Inc.

Test Facilities (4H). Fully illustrated 24-page brochure describes the facilities available for testing components and assemblies made under government contracts in accordance with military specifications. Inland Testing Laboratories.

Welding Electrodes (4J). Titled "The ABC's of Welding High Tensile Steels," 8-page booklet, in simple question and answer form, compares mild steel low hydrogen electrodes, as related to preheating, underbead cracking, moisture in the arc and in the coating, burn-off rate, cost of operation, applications, and stress relieving of the weldments. Arcos Corp.

Rubber Putty (4K). Catalog section on rubber putty offered. The putty is recommended for many types of glazing and sealing, and is particularly suitable where vibration, corrosion or moisture exists. Cites the advantages and gives complete directions for use. B. F. Goodrich Co.

Turbine Oil (4L). "What do you want to know about Turbine Oil?" answers questions that will help you solve turbine oil maintenance. Standard Oil Co. (Indiana).

Research Laboratories (4M). Illustrated 48-page brochure fully explains the services, facilities and personnel of the laboratories which are available to government agencies and private industry on a contract basis. Cook Research Laboratories, Div. of Cook Electric Co.

Slag & Sludge (4N). Combination of chemicals reduces slag, soot and flyash, according to 4-page folder. Also described is a treatment to eliminate sludge and moisture in fuel oil systems. Consolidated Engineers Co., Inc.

Solvent (4Q). Pamphlet describes odorless liquid that cleans air conditioning units and filters, motor housings and other greasy or oily items. May be applied by hand, brush or mechanical washers without harmful effects to the skin. Consolidated Engineers Co., Inc.

Filing Systems (4R). "How to Simplify Your Files and Filing Systems" is the subject of 40-page booklet. It outlines the essence of scientific filing, including the use of modern microfilming equipment. Remington Rand, Inc.

Nickel Chromium Steels (4S). Booklet on nickel chromium steel gives engineering data on working and treating. Tables of chemical composition, critical ranges and safe tempering temperatures, and annealing treatments comprise page 1. The following 6 pages contain diagrams on isothermal transforma-

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Up in the air, down in a pit, across the shop . . . you can really read the big, open dial of a Weston Thermometer. And because these rugged, all-metal instruments stand exposure, abuse—you know the temperature you read is *right*.

Despite the angle of tank side or pipe, there's a Weston Thermometer to fit it. You can get models with stems that are long or short, that project straight from the back or out the side at any 15° position around the periphery of the thermometer head—whatever you need for *your* application.

Various industrial, *Max-Min, and contact-making types are standard. Consult your Weston representative, or write Weston Electrical Instrument Corporation, 637 Frelinghuysen Avenue, Newark 5, New Jersey . . . makers of Weston and Tagliabue instruments.

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LOCKED IN STRENGTH of Tri-Lok open steel flooring gives efficient load distribution, even on long spans. Get maximum strength, light, and air with minimum weight. Available in Rectangular, Diagonal, and Super-Safety U-type Flooring, and Stair Treads of all kinds.

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HOT WATER AND STEAM GENERATORS FOR HEATING, PROCESSING OR POWER

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tion; tensile properties of the quenched and tempered metals; torsional properties of water quenched and tempered nickel chromium steels of different types and sizes. The International Nickel Co., Inc.

Concrete Floor Hardener (4T). Liquid that seals the pores and case hardens concrete floors is fully explained in 2-page bulletin. Full directions for use are included. Flexrock Co.

Rust Prevention (4U). Protection against rust for metal parts during manufacturing, in storage and in transit, is discussed in 4-page bulletin. Shows how this product removes fingerprints and deposits a thin, transparent film. Nox-Rust Chemical Corp.

For more information use one of the convenient reply cards on page 37. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you.

Sanitation & Maintenance (4V). "New Ideas on Plant Sanitation & Maintenance" is a 16-page booklet that gives specific answers to questions on maintenance and sanitation. G. H. Tennant Co.

Corrosion-Proof Enamel (4W). White corrosion-proof enamel is introduced in 4-page catalog that shows applications on all surfaces, even when damp. Prufcoat Laboratories, Inc.

Fire Extinguishers (4X). Full description, along with photographs, comprise 4-page bulletin on three new hand fire extinguishers. Lightweight construction and label color code feature chemical Foamite, chemical solution, and plain water models. American-La France-Foamite Corp.

Adhesives (4Y). Table, which lists by number each adhesive, the materials for which they are recommended, and application methods features 8-page catalog section. Lists specifications, including military, that it meets. The B. F. Goodrich Co.

Phosphate Coating Chemicals. (4Z). Detailed information about phosphate coating chemicals for paint-bonding, rustproofing, protecting friction surfaces, and improving drawing and extrusion is presented in 12-page bulletin. Gives recommended uses, application methods and temperature ranges for the various materials. American Chemical Paint Co.

Steel Hardeners (5A). Illustrated 6-page bulletin on gradient hardening with increased ductility of steel machinery parts, bearings, gears, etc., explains the principles, practice and method of examining the results. Wilson Carbon Co., Inc.

Fire Prevention (5D). Educational booklet on fire, suitable for distribution to fire protection personnel, is 4-page illustrated discussion of what fire is, classes of fire and proper methods of extinguishment. Ansul Chemical Co.

ARMSTRONG BROS.
Better PIPE TOOLS

CHAIN TONGS

"Reversible," "Standard" and "Ideal" types in all sizes. *Jaws* are drop forged from special steel, are carefully milled, heat treated hardened and tested. The *Handles* are forged spring steel. The *Chains* are proof-tested to 2/3 catalog strength (1,200 lb. to 40,000 lb.). "Reversible" Jaws give double jaw life. "Standard" Jaws have extra bearing on the handle and forged-in chain guides. The "Ideal" Tongs have V shaped teeth for a sure grip on irregular shapes — fittings, etc.

Write for Catalog

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5237 W. ARMSTRONG AVENUE • CHICAGO 30, ILL.

HINGED PLATEGRIP
BELT FASTENER No. 500

For Heavy Conveyor Belts of changing length

These heavy-duty belt fasteners make a strong, flexible joint in conveyor belts, belts of any width and of from 3/8" to 1/2" thickness. They offer special advantages in mines, quarries or industrial set-ups where length or position of belt is frequently changed, because sections can be removed or added at will. Joints are opened for this purpose by simply pulling out the hinge pin.

Easily and quickly applied on the job or in the shop. Special design gives deep compression into belting and smooth, flush joint.

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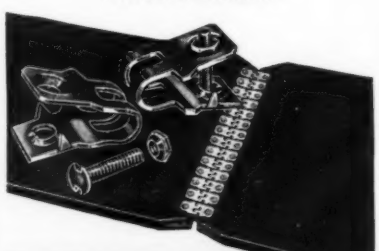


ARMSTRONG-BRAY & CO.
5376 Northwest Highway CHICAGO 30, U. S. A.

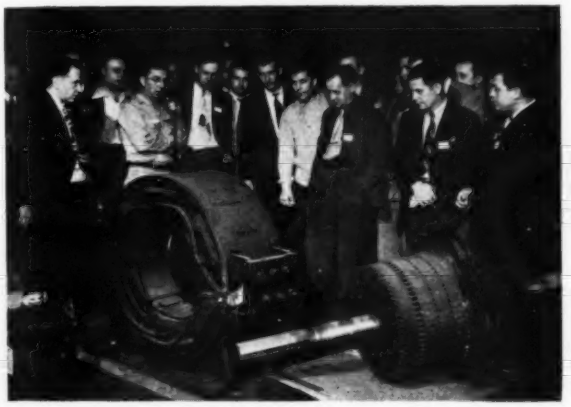
"SPOT" NEWS OF INDUSTRY

(Continued from page 109)

weighs about one-eighth as much as an identical length of lead sheathing. Significantly, the product developed by Alcoa is softer and more flexible than similar aluminum sheathing produced heretofore.

Westinghouse Maintenance School Well Received by 160 Students

One approach to the problem of combatting maintenance costs today is to share know-how with users of your equipment. At least that is the approach Westinghouse employed

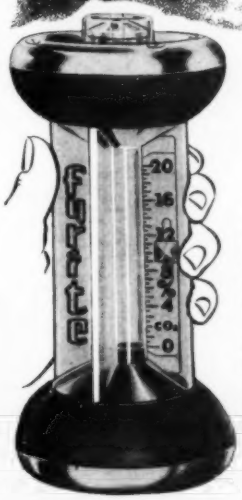


SMOKE PREVENTION

with the...

FYRITE

CO_2 INDICATOR



Instrument is packed in steel chest complete with gas sampling accessories

The relationship of the CO_2 test to smoke prevention is very close. A boiler that smokes is a boiler that is burning fuel inefficiently. CO_2 percentage in the flue gases—easily and quickly measured with the FYRITE—is an accurate, dependable index of combustion efficiency.

Checking CO_2 content of the flue gases regularly with the FYRITE is your best assurance of continuously maintaining maximum combustion efficiency, which insures fuel economy, long furnace life and freedom from smoke nuisance. This freedom from smoke is doubly important now with smoke abatement ordinances being enacted in a rapidly growing number of localities.

There is nothing tricky or complicated about a CO_2 test with the FYRITE—requires no skill or special training—there are no valves, clamps, or leveling bottle to manipulate—one test takes less than a minute.

Write for Bulletin 740

BACHARACH
Industrial Instrument Co.
7000 BENNETT STREET
PITTSBURGH 8, PA.

OXYGEN INDICATOR *employing FYRITE principle, for direct oxygen analysis, also available. Ask for Leaflet 700.*

GENERAL
REG. U.S. PAT. OFF.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE — Hazle Brook—*Premium Lehigh* Raven Run—*Premium Mahanoy*

Capable engineering personnel and the experience gained through long and varied marketing activity assure proper application of one of the above brands and effective servicing of any fuel requirement.

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Branches:

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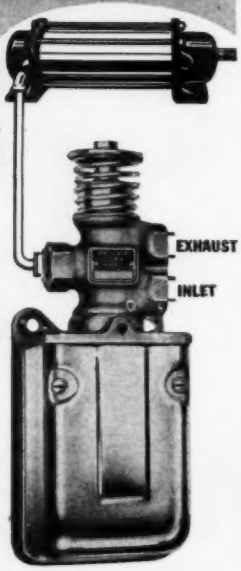
This VALVAIR SOLENOID OPERATED AIR CONTROL VALVE is Sensationally Dependable!



. . . and its dependability is due to many quality features. *Examples*: the "O-U" packer, no metal seats, heavy solenoid and standard pipe area through valve, permitting unrestricted air flow and preventing pressure loss. Yet Valvairs cost no more.

For use with air, water or oil pressures up to 175 p. s. i.; temperatures up to 120° F. 2-way; piped exhaust — 3-way, 4-way. Also in knob, lever, cam, clevis, foot, treadle, cylinder, diaphragm types.

Sizes: ¼", ⅜", ½", ¾", 1".

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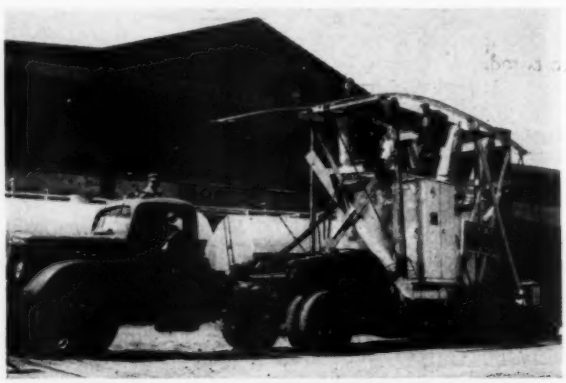
AFFILIATE: SINCLAIR-COLLINS VALVE CO.

Rely upon Valvair

recently in a six weeks' course in practical methods and practices given to 160 maintenance men.

Best and latest information available on maintenance of electrical equipment—primarily motors and controls—as well as some practical shop hints was given. The instructors were men who had spent an average of 20 years in maintenance work and, therefore, knew their subject.

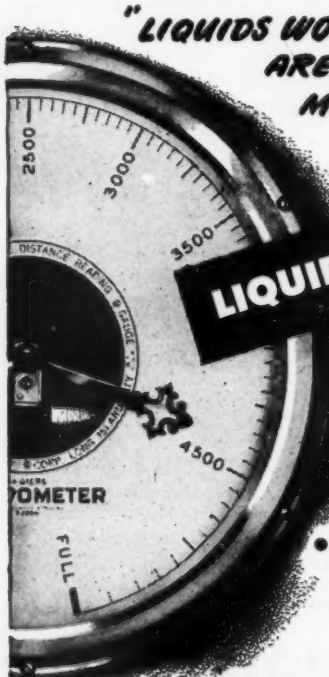
Topics covered were preventive maintenance; a-c motors; d-c motors; a-c and d-c controls; transformers and fractional horsepower motors; and plant safety.



RIGGING PROTECTS CIRCUIT BREAKER DURING DELIVERY

Inverted ski-like rigging 16 ft tall protected this 115-kw, 3,500,000-kva interrupting capacity oil circuit breaker from overhead wires during shipment from the Allis-Chalmers Works to the Montaup Electric Company's substation at Somerset, Mass. Shipped complete with bushings assembled resulted in an installation saving and reduced handling cost

"LIQUIDS WORTH STORING ARE WORTH MEASURING" with a LIQUIDOMETER Tank Gauge



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- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

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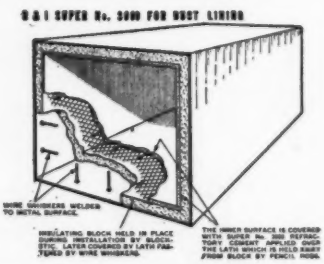
THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

Protects inside insulation of metal ducts, flues and breechings

New, Super refractory protects the insulation lining in ducts indefinitely.

High temperatures, corrosive, erosive and abrasive gases have little effect on R & I Super ♯3000.


R & I SUPER No. 3000 FOR DUCT LINING
WIRE WHISKERS WELDED TO METAL SURFACE.
INSULATING BLOCK HELD IN PLACE DURING INSTALLATION BY BLOCK-ETTE, LATER COVERED BY LATH FASTENED BY WIRE WHISKERS.
THE INNER SURFACE IS COVERED WITH SUPER No. 3000 REFRACTORY CEMENT APPLIED OVER THE LATH WHICH IS HELD AWAY FROM BLOCK BY PENCIL RODS.

Where all other materials fail, R & I Super ♯3000 gives lasting protection.

Easy to apply. Simply trowel ½" to ¾" thick over metal lath. Shipped ready-mixed in 200 lb. drums.

Write for bulletin describing Super ♯3000. Your supply house has it.

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119 Wall St., New York 5, N. Y.
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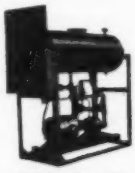
R&I Super #3000 Refractory Cement

whatever your elevator problem, the answer is

READING elevators

You can depend on Reading Elevators for superior machine design and construction in *all types* of freight elevators.

Electric



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READING ELEVATOR CO., Inc.
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NEW
Bulletin V-11

Order your copy today

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H & T Poppet Type Multiport Valves

built for Manual, Semi-Automatic or Fully Automatic Operation

Write for Bulletin V-11 and full details or a local representative will call.

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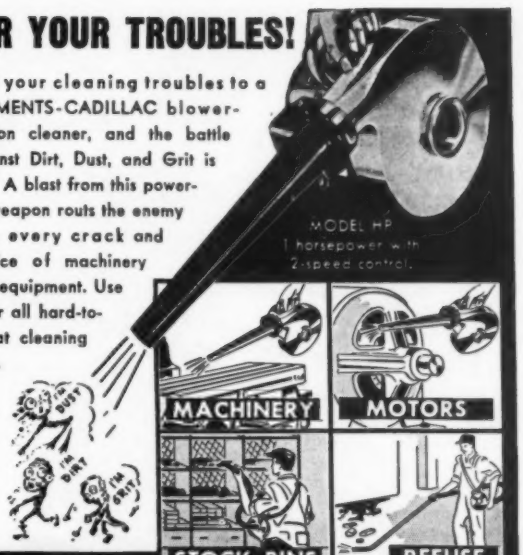
Clayton, New Jersey

Over 50 years experience—Over 5,000 installations

AIR YOUR TROUBLES!

Tell your cleaning troubles to a CLEMENTS-CADILLAC blower-suction cleaner, and the battle against Dirt, Dust, and Grit is won. A blast from this powerful weapon routs the enemy from every crack and crevice of machinery and equipment. Use it for all hard-to-get-at cleaning jobs.



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TIME • MONEY
PREVENT DAMAGE
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WITH THE . . .

Made in 5 models with attachments for every cleaning job.

PORTABLE COMBINATION
BLOWER-SUCTION CLEANER

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for BUSY FACTORY FLOORS

Avoid accidents! Prevent costly delays. Repair holes, cracks, broken places in concrete floors, or resurface an entire area with the durable RUGGEDWEAR RESURFACER. No chopping or chipping required. Merely sweep out spot to be repaired — mix the material — trowel it on. Holds solid and tight right up to irregular edge of old concrete. Used indoors or out. Dries fast.

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For a better drive, select the proper Cleveland unit

WRITE for copies of the latest Cleveland catalogs for full information on all types and sizes of worm gear speed reducers —including rating tables, dimensional diagrams and data for both standard and fan-cooled units. Ask for Catalog 200 for standard drives and Catalog 300 for Speed-aire (fan-cooled). The Cleveland Worm & Gear Co., 3255 East 80th St., Cleveland 4, O.

CLEVELAND
Worm Gear
Speed Reducers

Bureau of Reclamation Wants Civil Service Engineers

The U. S. Civil Service Commission has announced an examination for engineers to fill positions paying $4,600 and $5,400 a year in the Bureau of Reclamation. The positions are located in the West and Midwest.

Applicants will not be required to take a written test. To qualify, they must have completed a four year college course in engineering or have had four years of technical engineering experience, plus some specialized professional engineering experience.

Further information and application forms may be obtained from most first- and second-class post offices, civil service regional offices, or the Civil Service Commission, Washington 25, D. C.

Sales Position Clarified in Statement by United States Steel Corp.

Benjamin F. Fairless, president of U. S. Steel issued the following statement:

"Stories have reached us that certain individuals, purporting to be representatives of United States Steel, have stated the willingness of the corporation and its subsidiaries to sell steel at a premium to certain customers, or otherwise to engage in grey market transactions in these days of heavy steel demand. I want to deny categorically that these individuals have any authority to speak for the corporation.

Our policy continues to be one of selling steel only directly to bona fide customers at regular published prices. We will decline to make further sales to any purchaser who is found to have resold in the grey market steel bought from the corporation."

"TROUBLE FREE" *Control . . .*

TRERICE

SELF-OPERATING REGULATORS and DIAL THERMOMETERS

Constant Temperature Regulation for

• HOT WATER TANKS • PASTEURIZERS • PRE-HEATERS
• STORAGE ROOMS • VATS • PLATING TANKS
• COOKERS • FEED WATER HEATERS • WATER JACKETS

Cut your processing costs to a new low with the Trerice Self-Operating Regulator. This dependable, experience-proven regulator provides trouble-free control . . . eliminates over-heating! Saves you steam, fuel and labor while affording improved "quality control" over your product. Your low, initial investment in the Trerice Self-Operating Regulator and its companion piece, the Trerice Dial Thermometer, will be repaid many times over during their first year of service.

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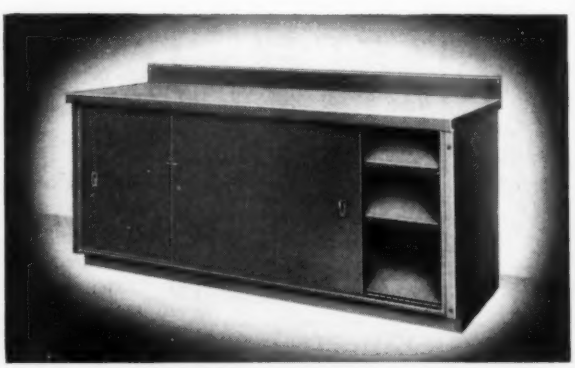

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. . . built for men accustomed to the finest tools and equipment

We "pulled out all the stops" when we designed the HALLOWELL Cabinet Bench, giving it more "custom" features than any other stock bench we know of. All-steel construction, choice of top materials, ample storage space, standardized units, interchangeable accessories, and trim good looks are just a few of its advantages.

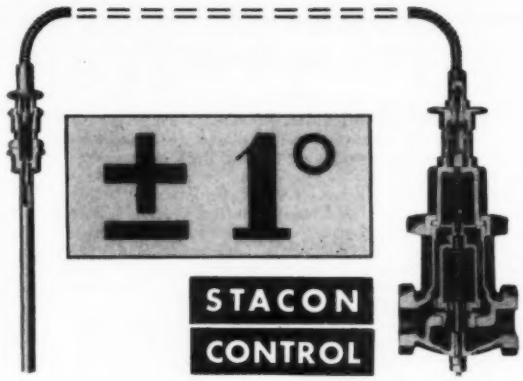
Bulletin 702 tells the story. Write for your copy today!

See us at Booth 2434, Convention of National Metal Congress and Exposition, Chicago, October 23 to 27

HALLOWELL

SHOP EQUIPMENT OF STEEL

SPS STANDARD PRESSED STEEL CO.
JENKINTOWN 39, PENNSYLVANIA



Temperature regulation to plus or minus one degree F. is the unheard-of accuracy obtainable with the self-operated Farris Stacon Temperature Regulator.*

Two design factors are responsible:

1. Liquid in bulb flashes to vapor in power bellows steam does 99 per cent of the work...without appreciable time lag.
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Stacon Regulators are compact, trouble-free, dirt-proof. They operate consistently in the worst possible surroundings and require no maintenance.

You'll want to learn more about the most sensitive, accurate, economical temperature regulator on the market. Write for Stacon Bulletin 50-1000.

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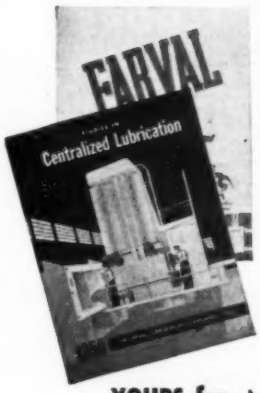
New report on savings with centralized lubrication



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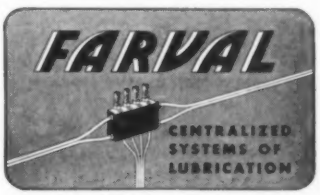
FOR more than 20 years, Farval has been saving money for users. Through efficient, dependable lubrication of machines and industrial equipment of all kinds, Farval saves 4 ways: It saves oiling labor, it saves lubricant, it reduces bearing expense, it eliminates down time.

The Farval System is a positive mechanical method of delivering oil or grease under pressure to a group of bearings from one Central Station, in exact quantities, as often as desired. It consists of a central pumping unit, two main supply lines and a measuring valve for each bearing.

Catalog No. 25 and "Case Studies—1950" give you the facts and figures. The Farval Corporation, 3253 East 80th Street, Cleveland 4, Ohio.



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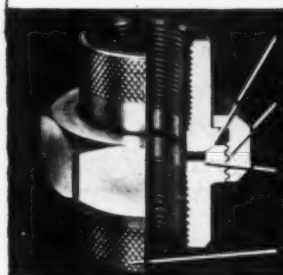
The all-steel union that gives you LEAK-PROOF SEALING . . . FASTER MAKE-UP . . . GREATER STRENGTH . . . LONGER LIFE.



1 WECO BALL AND CONE SEAL. Positive, leak-proof sealing.

2 ACME THREADS . . . Rugged. Resist damage and distortion. Make-up faster.

3 RESILIENT, REPLACEABLE GASKET . . . Protects metal-to-metal seal against abrasion, corrosion.

4 KNURLED SUB ENDS. Minimize wrench slippage. Safer.

WECO "Junior" unions are made for 3000-lb. non-shock cold working pressure, in sizes ⅛" through 2". Available in machined finish, Wecolyte cadmium plated or zinc coated. Other platings on request. All parts are interchangeable.

Conveniently packaged in sturdy cartons—Sizes ⅛" through 1" packed 24 to carton; larger than 1" packed 12 to carton.

Ask your Oil Field, Industrial or Mill Supply Store for WECO "JUNIOR" UNIONS. Illustrated brochure available. Write for your copy today.

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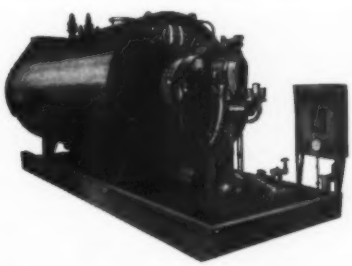

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Completely Equipped and tested at factory.

Fully Automatic. Heavy Oil, No. 6.

60 to 500 Horsepower plus ample overload.

Efficiency and Capacity proved in every day practical service and fully guaranteed.

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Please mail catalog with full information.

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When your concrete floors develop cracks, ruts, shallow holes or rough spots, repair them with Smooth-On No. 7B Quick Floor Patch Cement. It comes in powder form ready to mix with water. Simply apply Smooth-On No. 7B as you would plaster. Smooth-On No. 7B expands slightly as it hardens, insuring a secure, tight fit. You get an iron-hard surface that can take the punishment of heavy traffic. Order Smooth-On No. 7B Quick Floor Patch Cement in 1, 5, 20, or 100 lb. size.

FREE *Folder and Repair Handbook*

Write for your copy of the illustrated Smooth-On Quick Patch folder and the famous Smooth-On Repair Handbook. Pocket size, 40 pages, 170 simple illustrations. Shows how to make many time-saving, money-saving repairs.

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570 Communipaw Ave., Jersey City 4, N. J.

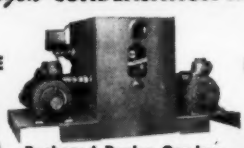
SO-349

Do it with **SMOOTH-ON**
QUICK FLOOR PATCH CEMENT

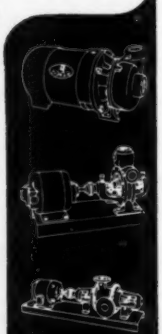
APCO *Packaged* CONDENSATION RETURN UNITS

for the SMALL LOW PRESSURE JOBS

10 to 40 lbs. with 8, 15, 30 Gallon Receivers



Packaged Duplex Condensation Return Unit with No. 4 Series Apco Pumps.



Start saving valuable heat units with APCO Square Tank Units. Built to meet demand for a smaller unit with the superb performance of our larger units. Remember, the Pumps are Apcos. No Vapor Binding — Special Provision for Expansion and Contraction — No Frictional Wear within pump. Thus, ECONOMY.

Write for Bulletin 113-ST

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42 Loucks Street, Aurora, Illinois

AVAILABLE REPRINTS

Copies of the complete editorial section of the September, 1949 issue, describing the plant engineering activities of the General Motors Corporation are available in a separately bound brochure. Price including mailing is 25 cents.

We also have a few copies of the following article reprints that are available free of charge to interested parties:

"Air Conditioning Cab Of Shovel Handling Steel Mill Slag", December, 1949.
"Boiler Houses Are Necessary Evils", February, 1950.
"Caribou Diesel Plant Built in a Hurry", February, 1950.
"Chain Belt's Newest Boiler is First 'Step' in 3-Step Plan", W. J. Thuerman, October, 1949.
"Crankcase Explosions are Rare—But . . . " October, 1949.
"Diesels In A Hydroelectric System", June, 1950.
"Electro-Motive's Steam Plant is Tops in Modernity", V. L. Wesby, September, 1949.
"Engineers 'Raise the Roof' for Harnischfeger's New Boiler", Anthony Sinclair, December, 1949.
"Falls City Production Not Hampered During Recent DC to AC Changeover", July, 1950.
"Gage Glasses, Their Composition and Selection", July, 1950.
"GM 'Utilities' Receive Major Attention", H. R. Smith, September, 1949.
"Grievances Can Be Avoided", April, 1950.
"How To Select Correct Steam Trap", Thomas Trail, January, 1950.
"How To Select Corrugated Expansion Joints", June, 1950.
"Insulation on 2000 psi Boiler Proves Effective", R. H. Boothby, October, 1949.
"Keep It Clean, says Oldsmobile", R. H. Barlow and W. E. Rasmussen, May, 1949.
"A Lamson Installation", Calvin A. Burton, August, 1949.
"Low Cost Auxiliary Power From Turbine Drives", April, 1950.
"Modernization at Toledo Laundry Cuts Steam Costs in Half", H. A. Quinn and S. T. French, October, 1949.
"Monsanto Builds Ideal Process Steam Plant at Everett, Mass.", June, 1950.
"Petoskey Diesel Plant Designed With An 'Eye-to-The-Future' ", May, 1949.
"Progress Being Made In Shale-To-Oil Program", R. A. Cattell, November, 1949.
"Qualifications of an Effective Industrial Supervisor", A. A. Potter, June, 1949.
"Select Correct Batteries for Starting Diesels", K. A. Vaughn, November, 1949.
"Signode Plant 'Pressurized' to Eliminate Cold Drafts", November, 1949.
"Simplify Determinations of Pipeline Pressure Losses", J. O. Mullen and H. D. Fisher, November, 1949.
"Steam, Air, and Power for 3 New Ford Assembly Plants", R. M. Doering, May, 1949.
"The Story of Thermal Electric", A. G. Purdue, March, 1949.
"Supervisors Must Develop Favorable Group Attitudes", Edmund Mottershead, November, 1949.
"Supervisor's Personal Check-Up Chart", November, 1949.
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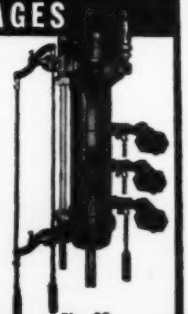

Fig. 83

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TYler 7-5592

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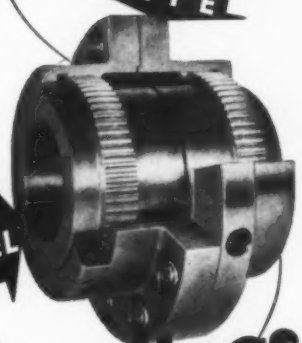

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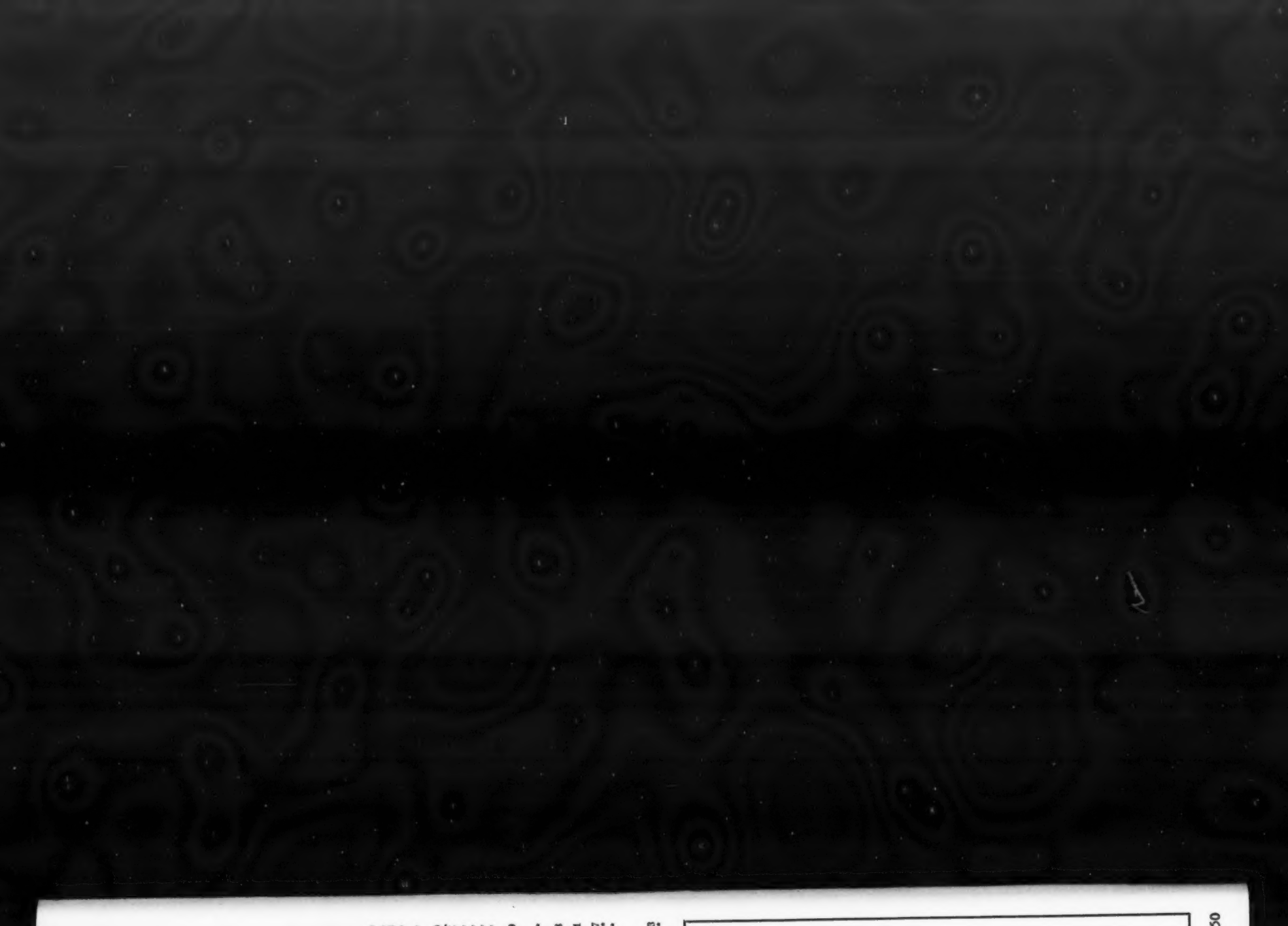
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